

613-620

**COMMUNITY REACTIONS TO SONIC BOOMS
IN THE OKLAHOMA CITY AREA**

PAUL N. BORSKY

FOREWORD

This study was initiated with funds provided by the office of Supersonic Transport Development, Federal Aviation Agency, Washington 25, D.C., by the Biophysics Laboratory, Aerospace Medical Research Laboratories, Wright-Patterson Air Force Base, Ohio. The research was conducted under contract AF 33(657)-11148 by the National Opinion Research Center, University of Chicago, 55 Fifth Avenue, New York, N.Y. 10003. Mr. Paul Borsky was the principal investigator for National Opinion Research Center. Dr. Charles W. Nixon of the Biodynamics and Bionics Division was the contract monitor for the Aerospace Medical Research Laboratories. The work was performed in support of Project No. 7231, "Biomechanics of Aerospace Operations," and Task No. 723103, "Biological Acoustics in Aerospace Environments." The research sponsored by this contract was started in April 1963 and completed in February 1965.

This report is cataloged by the National Opinion Research Center as Report No. 101.

This technical report has been reviewed and is approved.

J.W. HEIM, PhD
Technical Director
Biophysics Laboratory

ABSTRACT

The Oklahoma City, Oklahoma, area was repeatedly exposed to sonic booms generated by a simulated schedule of supersonic transport overflights during a period of 6 months from February to July 1964. The schedule provided for eight sonic booms per day programed at an intensity of 1.5 pounds per square foot (PSF) during the first portion of the study and 2.0 PSF during the latter stages. Almost 3000 local residents were personally interviewed three times during the 6-month period to determine the nature and extent of their reactions to the sonic booms. Among the findings it was shown that substantial numbers of residents reported interruptions of ordinary living activities, and some annoyance with these interruptions, however, the overwhelming majority felt they could learn to live with the numbers and kinds of booms experienced during the 6-month study.

Table of Contents

	<u>Page</u>
COMMENTARY ON THE NORC REPORT ON COMMUNITY REACTIONS TO SONIC BOOM	ix
I SUMMARY.	1
A. Research Approach.	1
B. Reported Overall Reactions to Sonic Booms in Oklahoma City Area	1
1. Interference with ordinary living activities.	1
2. Annoyance with sonic booms.	1
3. Desires to complain and actual complaints about sonic booms	2
4. Long range acceptability of sonic booms	2
C. The Expected Range in Public Reactions to Sonic Booms. . .	4
1. Range in annoyance reactions to sonic booms	4
2. Range in reported desires to complain and actual complaints about sonic booms.	4
3. Range in reported long range acceptability of sonic booms	5
D. Other Related Findings	5
1. General factors affecting complaints in Oklahoma City.	5
2. Importance of aviation to Oklahoma City	5
3. Importance of belief that sonic booms cause damage. .	5
4. General reliability of interview responses.	6
5. Relation of distance from SST flight track and reactions to sonic boom	6
6. Reactions of urban and rural populations.	6
7. Effects of night booms on community reactions	6
II INTRODUCTION	7
III CHARACTERISTICS OF THE ACTUAL SONIC BOOM EXPOSURES	9
IV PERSONAL INTERVIEW FINDINGS.	11
A. Number and Type of Interviews.	11
B. Some Basic Characteristics of the Oklahoma City Area . . .	14

	<u>Page</u>
C. Reported Overall Reactions to Sonic Booms in Oklahoma City Area.	14
1. Reports of Interference	14
2. Reports of Annoyance.	16
3. Reports of Damage by Sonic Booms.	18
4. Reports of Desires to Complain and Actual Complaints about Sonic Booms	21
5. Long Range Acceptability of Sonic Booms	21
D. Effects of Belief in Importance of Supersonic Transport And Feelings about the Absolute Necessity of Having Local Booms on Reactions to Sonic Booms.	26
1. Feelings about Necessity of Local Booms	27
2. Reports of Annoyance.	27
3. Desires to Complain about Booms	30
4. Long Range Acceptability of Sonic Booms	30
E. Effects of Feelings about Necessity of Local Booms and More than a Little Annoyance on Reactions to Booms	30
1. Reports of Annoyance.	30
2. Desires to Complain	34
3. Long Range Acceptability.	34
4. Reports of Damage	34
F. Some Characteristics of Actual Complainers	39
1. Reports of Damage	39
2. Long Range Acceptability.	39
3. Personal Characteristics.	39
G. Some Remaining Gaps in Knowledge About Community Reactions to Sonic Booms	43
1. The Effects of Nighttime Booms.	43
2. The Effects of Sonic Booms Above the Intensity of 1.5 PSF	43
3. Effects of Time on Acceptability of Sonic Booms	43
4. Effects of Optimum Public Information Program	43

List of Tables

	<u>Page</u>
1. Overall Reactions to Sonic Booms	3
2. Actual Measurement of Sonic Boom Overpressures by Distance from Ground Track	10
3. Interviews completed	13
4. Reported Types of Interference by Sonic Booms by Distance from Ground Track	15
5. Reported More than a Little Annoyance by Types of Interference and Distance from Ground Track	17
6. Reported Interference and Annoyance by Sonic Booms	19
7. Number Reports of Damage by Sonic Booms by Distance from Ground Track.	20
8. Complaint Potential for Booms - Persons Felt Like Complaining. . .	22
9. Number of Actual Reported Complaints About Booms by Distance from Ground Track.	23
10. Comparison of General and Boom Complaint Potentials.	24
11. Reported Ability to Accept Eight Booms per Day	25
12. Reported Belief in the Absolute Necessity of Local Booms by Belief in the Necessity for Developing an SST.	28
13. Reported More than a Little Annoyance with Booms by Belief in Necessity for Developing an SST and Necessity of Making Booms Locally.	29
14. Reported Complaint Potential with Booms by Belief in Necessity for Developing an SST and Necessity of Making Booms Locally. . . .	31
15. Reported Ability to Accept Eight Booms per Day by Belief in Necessity for Developing an SST and Necessity of Making Booms Locally.	32
16. Reported More than a Little Annoyance with Booms by Feelings of Necessity and Annoyance with Booms at End of Study	33
17. Complaint Potential for Booms by Feelings of Necessity and Annoyance with Booms at End of Study	35

	<u>Page</u>
18. Actual Complaints About Booms by Feelings of Necessity and Annoyance with Booms at End of Study	36
19. Reported Ability to Accept Eight Booms per Day by Feelings of Necessity and Annoyance with Booms at End of Study	37
20. Reports of Damage by Booms by Feelings of Necessity and Annoyance with Booms at End of Study	38
21. Reports of Damage by Complainers and Non-Complainers	40
22. Reported Ability to Accept Eight Booms per Day and Several by Night by Complainers and Non-Complainers	41
23. Selected Personal Characteristics of Complainers and Non-Complainers.	42

COMMENTARY ON THE NORC REPORT ON COMMUNITY REACTIONS TO SONIC BOOM

Dr. John R. Dunning

Dean, Columbia University School of Engineering and Applied Science

Chairman, National Academy of Sciences Sonic Boom Committee

Gordon M. Bain

Deputy Administrator for Supersonic Transport Development

Federal Aviation Agency

The report of the National Opinion Research Center on Community Reactions to Sonic Booms, based on tests in the Oklahoma City area from February to July, 1964, is a significant addition to the store of available knowledge on this highly important subject.

In studying the sonic boom and the effects that would result from the operation of supersonic transports, it is necessary to provide expert knowledge in a number of areas, such as the aeronautical aspects of the problem, the effects of the sonic boom on structures and on structural materials, and in the most difficult area of all sonic boom problems and where the most elusive questions lie--the public response. There is little doubt that the more we can learn from tests and studies about the effects of the boom on people, and their reactions, the better we can define and meet these problems. There is a great need for studies in this area, and they must be encouraged even though it is recognized there is difficulty in devising tests that can measure adverse or acceptable public responses in a meaningful manner that will reflect the cumulative response to booms which the population might have to face eventually with operational supersonic transports.

The National Opinion Research Center report is one of the most thorough yet made on the subject. It is concerned only with the Oklahoma

City tests, but it is expected that it will be supplemented by reports on future tests in other localities and under other conditions, including night flights and the use of different types of aircraft. It will be studied with interest by scientists and experts on human behavior, and will assist them in devising later studies to expand research and knowledge in this vital area.

This report and similar ones also should be helpful in developing design of the SST which ~~minimizes~~ the sonic boom and any resultant adverse public response.



The Oklahoma City sonic boom study from February 3 through July 30, 1964, was the first major effort anywhere in the world to determine the nature of public reaction to sonic boom at specified, measured levels over a reasonably extended period of time.

At this early stage in the development of supersonic transportation in a number of parts of the world, this was a most important, most valuable study. The description "historic" may well be accorded to it in recognition of the vast influence that transportation and technological development, and their by-products, exercise over men and nations.

This Oklahoma City study also represents an approach to the matter of sonic boom that is in the best traditions of American life. Faced with this aspect of supersonic flight, the United States Government's response has been twofold. A major program of technical research has been mounted to examine the nature of sonic boom and methods of diminishing it. At the same time, an equally determined effort has begun to determine, simply, "How will people feel about it?"

The Oklahoma City program has been the principal public manifestation of this concern to date. This was a direct, straightforward

In fact, there appears to have been very little actual cause for apprehension of property damage in most cases during the Oklahoma City study. This statement would remain an accurate reflection of the Oklahoma City experience even if one were to assume for discussion purposes that investigation led to approval of every one of the 4,530 damage claims filed during and following the flight phase of the study, which was not the case. It also reflects other research and experience.

Approximately 1,500 damage claims were received by the Air Force as a result of sonic booms at an air show in Oklahoma City in 1956. The overpressures of these low-altitude sonic booms were not measured, but it is known that they were notably higher than those generated in the 1964 study program. At Edwards Air Force Base, California, an average of seven booms is generated daily at varying overpressures. Eighteen claims of sonic boom damage have been filed by persons in the surrounding area during fiscal years 1964 and 1965. The area has experienced several thousand sonic booms during this time period.

A dual requirement would appear to have been created by this survey finding--a matter of fact and communication. Extensive structural testing built on past research and experience, such as the recently completed sonic boom structural response program at White Sands Missile Range, New Mexico, will have to be conducted. Data thus gathered will feed into design and operational requirements for the United States SST. This information must be communicated to the public. Such a program got under way with the White Sands Study and plans call for it to continue in the future.

The Oklahoma City research itself, of course, was not a structural study, but a study of public reaction. It did, however, have structural aspects.

Research and experience prior to the Oklahoma City study, including extensive Department of Defense experience in operation of supersonic military aircraft, pointed to the conclusion that structural and material damage should not be expected at sonic boom overpressures in the 1.0 to 2.0 pound range scheduled in the program.

Test houses rented by FAA in the Oklahoma City area for instrumentation and observation provided a kind of structural "control" for the study, an important safeguard in relation to property damage in the area while at the same time recording sonic boom response data.

Test house findings and experience substantially agreed with results of previous sonic boom research and operations. The test houses showed no discernible damage, although the research engineers (See "Structural Response to Sonic Booms," prepared by the Oklahoma City engineering firms Andrews Associates and Hudgins, Thompson, Ball Associates as part of the over-all Oklahoma City study report) did infer that vibrations caused by sonic booms "accelerated hairline cracking of paint

finish at corners" and "cracking of paint finish over nailheads" in two of the houses.

Results in the three stages of the public opinion survey indicated that the majority of Oklahoma Cityans who found the booms acceptable decreased by 17 per cent during the course of the program, between the first and the last interview. During this period, the scheduled overpressure level generated by study aircraft rose from 1.5 pounds per square foot to 2.0 pounds. The level 1.5 pounds is the maximum set for the United States SST in cruise, during which it would be flying over populated areas, 2.0 pounds the maximum for the short period of transonic acceleration at a distance of 100 to 150 miles from the departure airport. The report finds that "most of the increase in annoyance" during this period was caused by the increase in overpressure level rather than the length of the program or other causes.

Should one agree that this was the case? If so, this finding marks a major step toward identification of the specific level of overpressure that may be widely acceptable. Or were there other factors?

For one thing, the Air Force F-101 aircraft, which generates a particularly sharp-sounding sonic boom, was introduced into the program during the period. This may be a key point, because indications appear to be that characteristics of the sonic boom in addition to the quantitative level of overpressure may be most important both in terms of public acceptability and potential structural response. The nature of the boom from a large supersonic plane could prove to be significantly different from a boom of the same overpressure generated by a smaller plane such as those used over Oklahoma City. There is evidence to indicate that the sonic boom created by the larger SST could prove more acceptable than the one created by the smaller supersonic aircraft. The subject will have to be explored through flights of the Air Force B-70.

Second, some organized opposition to the sonic boom study program began to be heard as the weeks passed, and this may well have acted on the annoyance level during the course of the study. Again, this is a variable.

Further, the scheduled overpressure level was intentionally dropped during one period in July, and there was no apparent effect on public reaction as shown through the NORC survey or the telephone "complaint center" operated during the program by a local firm under contract to the Federal Aviation Agency. What does this mean?

Or does this survey finding indicate, really, that people became annoyed with sonic booms as a function of the time they were exposed to it--a conclusion of especial significance in terms of supersonic airline operations. The National Opinion Research Center analysts did not feel this was the case.

How, in any event, do you determine general acceptability? How large a majority that finds sonic booms acceptable at a particular level would be required for the Government to judge that level acceptable to the general public? This is another question raised by the survey. It is a question that deals not only in overpressures and statistics, but in the nature of decision-making in a democracy, and it also requires further attention as we continue sonic boom study in this country and other research is initiated overseas.

The report that follows, with all of its conclusions and questions, should help point the way for the body of Government and industry scientists, engineers, and technical administrators charged with responsibility in this national undertaking. Much work and study remain to be done.

Gordon M. Bain

I. SUMMARY

A. Research Approach

Community reactions to sonic booms will influence the operating characteristics of commercial supersonic aircraft (SST). The planning of SST flight profiles, schedules, and routes over land will depend in part on the extent to which the general public accepts sonic booms resulting from such flights. The National Government's recognition of this problem and its desire to have the SST operate in a manner generally acceptable to the public interest has led to various sonic boom research programs. Among these programs was the Oklahoma City sonic boom study in which the community was repeatedly exposed to a simulated schedule of SST overflights and the reactions of the public to the sonic booms were ascertained.

A total of 1253 sonic booms were actually generated in the Oklahoma City area over a period of six months, from February to July 1964. The intensity of the booms was scheduled for 1.5 pounds per square foot (PSF) for most of the study and for 2.0 PSF during the latter stage. Atmospheric conditions and other practical problems, however, tended to reduce somewhat the actual average intensities of the booms under the flight track to 1.13 PSF during the first 11 weeks, 1.23 PSF during the next eight weeks and to 1.60 PSF during the final seven weeks of the program.

Almost 3000 adults representing a scientifically selected cross section of local residents were personally interviewed three times during the six months period to determine their reactions to the sonic booms. In addition, careful records were kept of all complaints received by the local Federal Aviation Agency representatives. The analyses of these representative interviews and local records are included in this report.

B. Reported Overall Reactions to Sonic Booms in Oklahoma City Area

Substantial numbers of residents reported interferences with ordinary living activities and annoyance with such interruptions, but the overwhelming majority felt they could learn to live with the numbers and kinds of booms experienced during the six month study.

1. Interference with Ordinary Living Activities

Some interferences or interruptions of ordinary living activities, principally house rattles and vibrations, were reported by almost all respondents. Startle and fear of booms were next in importance, being mentioned by 40% of all close residents and 30% of the more distant ones. Sleep, rest and conversation interference were mentioned by 10-15% of the close residents and about 5% of the distant residents during most of the program.

2. Annoyance with Sonic Booms

Serious or "more than a little" annoyance with sonic booms was generally reported by a minority of the residents during the first and second interviews, but increased to a slight majority by the end of the six months program.

After the first 11 weeks when the median boom level was 1.13 PSF, only 37% reported serious annoyance. This increased to 44% annoyed when the boom level rose to 1.23 PSF and to 56% annoyed when the booms averaged 1.60 PSF. This rise in annoyance over time is believed due primarily to the increase in the intensity of the sonic booms, but part of it also may be due to greater annoyance with continued exposure.

3. Desires to Complain and Actual Complaints About Sonic Booms

About half of all persons seriously annoyed with the sonic booms also felt like complaining to the authorities. Only a small fraction of these actually followed through and contacted the FAA. During the first interview, desires to complain about the booms were reported by only 16% of all residents. This number increased to 23% during the second period and remained at 22% during the final interview. Even fewer, less than 5% of all residents, actually called the F.A.A. office during the entire six month period. Thus, only one in every twelve annoyed persons actually expressed their feelings to the F.A.A. complaint center.

This relatively low complaint level in Oklahoma City was due primarily to three factors. First, there was widespread ignorance about where to complain; 70% of all respondents expressed such ignorance in the interview. Second, there was a general feeling of futility in the usefulness of complaining; only 4% felt there was a "very good" chance of doing something about the booms, and another 10% felt there was even a "good" chance to do something. Third, the general pattern of complaining about local problems was low in Oklahoma City; only about a fourth of all people felt like complaining about a serious local problem when they had one.

4. Long Range Acceptability of Sonic Booms

Respondents were asked to evaluate their own six month experience with the sonic booms and to report whether or not they felt they could learn to live with eight booms a day for an indefinite period. The overwhelming majority felt they could accept the booms under these conditions. During the first 11 weeks of the study, over 90% felt they could accept the eight daily booms. This number dropped to 81% during the following eight weeks and to 73% during the final seven weeks of the study. At the end of six months, about one-fourth of all people felt they could not learn to accept the booms.

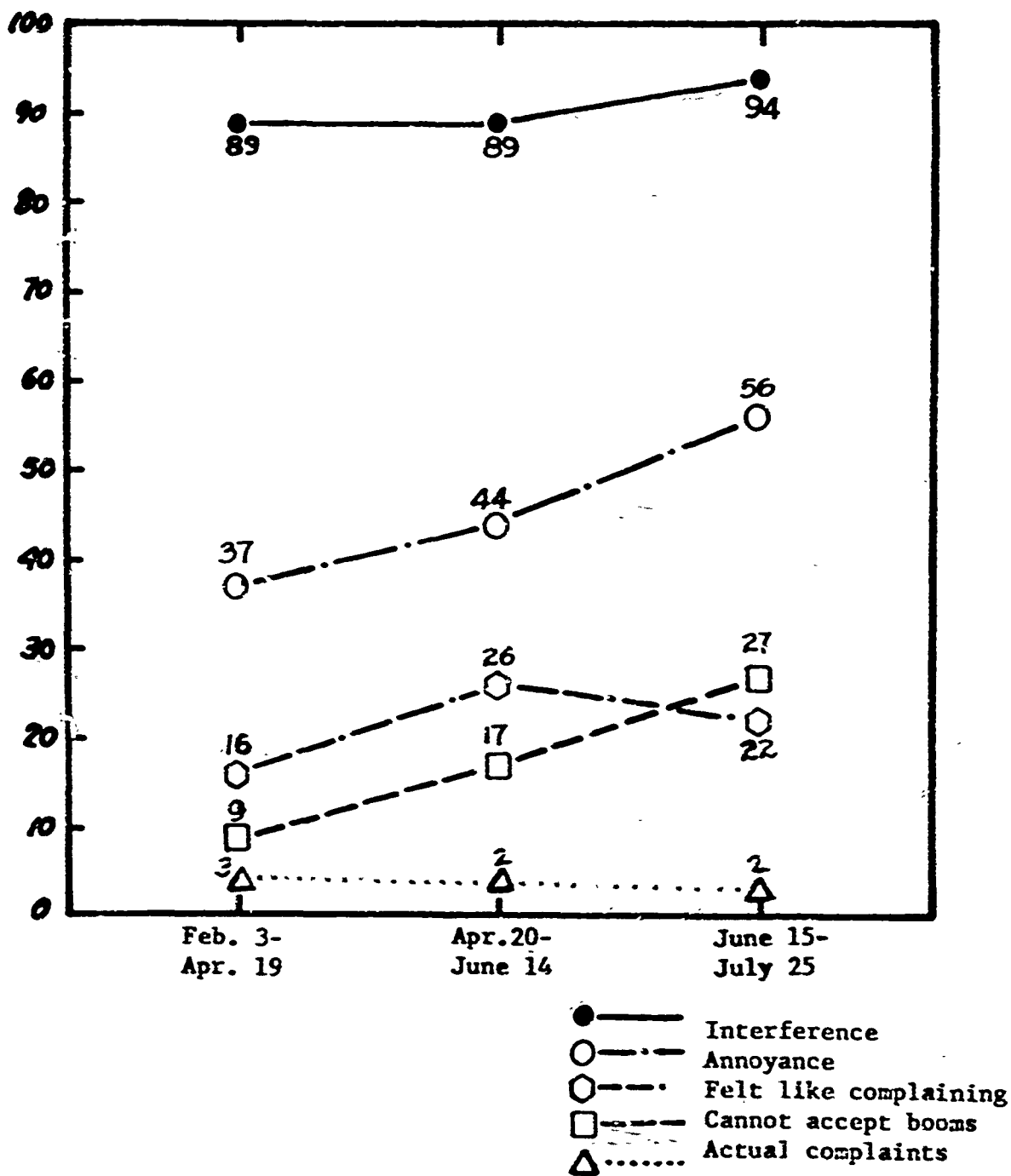
Table 1 graphically summarizes the above major public reactions to the sonic booms.

Table I

OVERALL REACTIONS TO SONIC BOOMS

Oklahoma City Area
February-July 1964

Percent
Reporting



C. The Expected Range in Public Reactions to Sonic Booms

The range in reactions to sonic booms found among different types of residents in Oklahoma City offers guide lines on what kinds of reaction could be expected throughout the United States. Three different basic attitudes have been found to affect greatly the willingness of people to accept or reject sonic booms. When these attitudes are favorable, they tend to create maximum acceptability of booms, while the presence of opposite or unfavorable attitudes produces what might be considered a minimum acceptability level. Most areas in the U.S. would fall somewhere in between the two extremes depending on the particular combination of favorable and unfavorable attitudes in a specific community.

The three favorable attitudes are:

- a) Belief that the SST is absolutely essential to the welfare of the United States.
- b) Belief that sonic booms are unavoidable and are necessary locally.
- c) Belief that sonic booms do not cause damage to persons and property.

The effects of these attitudes on reactions of Oklahoma City residents to sonic booms are shown below.

1. Range in Annoyance Reactions to Sonic Booms

Annoyance was reported by only 13% of all persons holding the most favorable attitudes during the first interview. This increased as the intensity of the boom increased to 26% annoyed during the second interview and remained at 25% annoyed at the end of the study. This is considered the minimum annoyance reaction that could be expected since it is reported by those persons holding the most favorable attitudes. In contrast, annoyance was reported by 57% of those persons with the least favorable attitudes during the first period, about the same during the second period, and a maximum of 76% reported annoyance at the end of six months.

Thus, at the end of the study, annoyance ranged from a minimum of 25% to a maximum of 76%.

2. Range in Reported Desires to Complain and Actual Complaints About Sonic Booms

Practically none of the persons with the most favorable attitudes toward booms wanted to or actually did complain. Only 2% felt like complaining during the first period, 5% during the second period and 4% during the final interview. In contrast, those persons with the most unfavorable attitudes report that 34% wanted to complain during the first interview, 39% during the second and 37% during the final interview. The number actually complaining ranged from just over 1% for the most favorable to 11% for the least favorable attitude groups. The range in desires to complain at the end of the six months extended from a minimum of 4% to a maximum of 37%.

3. Range in Reported Long Range Acceptability of Sonic Booms

After six months exposure, over 90% of all persons with the most favorable attitudes felt they could accept eight daily booms indefinitely. Acceptability was 99% during the first interview, but this dropped to 94% during the second phase and finally leveled at 92% at the end of the study. The importance of these basic sonic boom attitude differences is most dramatically revealed in the reports of those with the least favorable attitudes. Only 78% felt they could accept the booms at the time of the first interview. This acceptability dropped sharply to 62% at the second period and fell further to 57% at the end of this program.

Thus, the maximum acceptability of booms was 92% and the minimum acceptability was only 57% at the end of the study.

D. Other Related Findings

1. General Factors Affecting Complaints in Oklahoma City

Residents of Oklahoma City have a very high attachment and satisfaction with their community. Only 3% report they dislike "many things" in their local areas, and 80% rate their area as an "excellent" or "good" place to live. This high satisfaction is coupled with general reluctance to complain about local problems. Only 28% of all residents felt there was a serious local problem and wanted to do something about the problem. Even fewer, only 10% said they actually wrote or telephoned an official about it. This local apathy may be due largely to feelings of futility in complaining. Only 12% felt complaining had even a "good" chance of accomplishing something.

2. Importance of Aviation to Oklahoma City

Almost a third of all Oklahoma City residents have had personal or family connections with the aviation industry. This extreme economic importance of local aviation is recognized by over 75% of all residents. It is this general recognition of the important role of local aviation which contributed to the generally favorable attitudes toward the SST development and, thus, to the reported acceptance of local sonic booms. Whether or not residents had direct ties with the aviation industry did not appear to bias their reactions to sonic booms. About the same proportions of those with and without direct ties felt it was proper to complain about booms if annoyed, that the SST was important and that local booms were unavoidable and necessary.

3. Importance of Belief that Sonic Booms Cause Damage

Direct scientific evidence indicates that the Oklahoma City booms did not cause any significant damage to the local test houses, which were instrumented by the FAA to measure physical effects of booms. Large numbers of residents, however, felt their houses had been damaged. Over 40% overall felt this way, while 50% of the annoyed and 86% of the actual complainers also felt this way. This clearly suggests that belief in alleged damage increased annoyance and complaint activity.

4. General Reliability of Interview Responses

All indications are that responses in this study are highly reliable. Most residents had heard or read about the general FAA boom study, but only 5% knew about the NORC personal interviews. Such a small number of knowledgeable persons could not greatly bias the overall findings. Independent samples of respondents, moreover, selected scientifically from Oklahoma City residents during each interview period, likewise revealed no significant differences in reactions to sonic booms. Finally, residents living in different communities and experiencing comparable boom intensities reported almost identical annoyance levels. The above and other technical tests give confidence in the reliability of the survey data.

5. Relation of Distance from SST Flight Track and Reactions to Sonic Boom

Most annoyance, reports of damage, desires to complain and actual complaints were reported by the closest residents living 0-8 miles from flight track. Residents in the middle distance group (8-12 miles) were next in order, followed by the most distant residents (12-16 miles away) who reported the least reaction to the sonic booms.

6. Reactions of Urban and Rural Populations

No significant differences in reaction to booms were found between urban and rural residents in the Oklahoma City area.

7. Effects of Night Booms on Community Reactions

No direct evaluation of this factor can be made since no night booms were generated during the study. Sleep interference reported by daytime sleepers, however, indicates that greater annoyance may be associated with sleep interference. Further study of night booms should determine whether annoyance with such booms also increases hostile reaction to daytime booms.

II. INTRODUCTION

Purpose of study: Community reactions to sonic booms will have an influence on operating characteristics of commercial supersonic aircraft, particularly for planning flight profiles, schedules, and route structures over land. The National Government's recognition of this problem and its interest in operating the SST in a manner acceptable to the general public has led to various sonic boom research programs. Among these programs was the Oklahoma City sonic boom study designed to provide a measure of the degree of community acceptance of sonic booms of varying intensities and to provide additional information which might assist SST managers and operators in making decisions regarding commercial supersonic operations.

Selection of test site: The metropolitan area of Oklahoma City, Oklahoma, was selected for study of community reactions to sonic booms because of many features favorable to such a study. Among them were some previous sonic boom experience, military and civilian propeller and jet operations, no irregular topographic features, structures and buildings of various types and ages, test aircraft staging area, as well as other technical characteristics considered necessary for the accomplishment of the program.

Flight schedule: The overall study program provided for a carefully simulated SST flight operation. Eight supersonic flights per day, during a six month period, were flown regularly during the morning and early afternoon over a predetermined flight track. The sonic booms thus generated were programmed at a given intensity by controlling the operations of the aircraft. The actual intensity or overpressure level of the boom was measured by engineers at various locations on the ground.

The flight track was established to cross densely populated areas, both urban and rural, both newly developed and established communities. Since the calculated overpressures diminish as a function of lateral distance from the flight track, the populated areas were stratified so that three different boom stimulus groups would be obtained. The boom intensities were approximately equal within each distance group.

Features of Boom Test: The full study program included the establishment of an FAA complaint center to receive any public responses, complaints or reports of damage, the evaluation by engineers of any alleged damage, and the instrumentation of test structures in the area and their controlled observation of any boom damage by engineers. The program also provided a public information program designed to explain the purposes of the study and the characteristics of sonic booms.

Sample Design: A representative sample of adult residents from all communities was selected from each of the three distance groups, up to 8 miles from flight track, from 8-12 miles and from 12-16 miles from flight or ground track. These same adult respondents were personally interviewed three times during the six month period. The first interview occurred after 11 weeks of boom exposure, the second after eight more weeks of booming and the last after six more weeks of booms.

Interview design: The interview did not at any time reveal the purpose of the study but was described as a broad community survey of how people felt about living in their areas. Questions about overall attitudes toward all kinds of local problems were included as well as specific probes about knowledge, beliefs, attitudes and reactions to the sonic boom exposures. Since the boom study was widely publicized, the respondent usually mentioned it voluntarily before direct questions were asked about it.

Organization of NORC report: This report will be structured primarily around the following four types of operationally defined community reactions:

1) Interference or the extent to which booms are reported as interfering with selected living activities.

2) Annoyance or the extent to which feelings of annoyance result from these interferences.

3) Complaints or the extent to which people feel like and actually do complain about the booms.

4) Long range acceptance or the extent to which people feel they can accept sonic booms over an indefinite period of time.

All of these reactions will be related to the measured differences in over-pressure levels as determined by the distance of each resident's dwelling from the ground track of the sonic boom flight.

This report is the first of two documents which will comprise the NORC Final Report. It contains only the major findings of the study. The second document, to be available in the near future, will be much more detailed and complete.

III. CHARACTERISTICS OF THE ACTUAL SONIC BOOM EXPOSURES

Scheduled overpressures: During the first three weeks of the sonic boom study, the scheduled overpressure was increased gradually from 1.0 to 1.5 pounds per square foot (PSF), and from one per day to eight per day. From the fourth week to about the nineteenth week, this schedule of eight 1.5 PSF booms was maintained. During the last seven weeks of the study the scheduled overpressure was increased to 2.0 PSF, but the frequency was kept at eight per day. Table 2 presents a summary of actual measurements of sonic boom levels. The generally lower than calculated overpressure levels were due to atmospheric effects and other operational factors.

Actual overpressures first 11 weeks: During the first 11 weeks of the program, half of the booms measured only 1.13 PSF or less at the closest areas, up to 8 miles from ground track. Only 16% of the booms measured as much as the scheduled level of 1.5 PSF, and only 2% measured as much as 2 PSF or more. Dwellings 8-12 miles distant from the ground track and those 12-16 miles away experienced somewhat lower overpressure levels. The middle distance area had 50% of its booms at only 0.8 PSF or less, while the distant area reported half at 0.65 PSF or less.

Actual overpressures remainder of study: During the second time period (April 20-June 14) the actual overpressure levels were increased a little so the median values rose to 1.23 PSF for the 0-8 mile group, 1.10 for the middle group and .85 for the distant group. During this period only 3 out of 10 booms reached the scheduled 1.5 PSF at the closest areas. Only during the third phase of the study did the actual boom level in the close areas reach 1.5 PSF in 60% of the occurrences, while the scheduled 2.0 PSF was achieved in only 22% of the time.

It is interesting to note that the actual boom level for the closest areas during the first period is about equal to the level of the second distance group in the second time period and the third distance group during the third time period. As we shall see in Table 6, annoyance reactions were almost equal during these comparable boom stimulus exposures. This gives confidence to the reliability of the interview reports.

Table 2

**ACTUAL MEASUREMENTS OF SONIC BOOM OVERPRESSURES
BY DISTANCE FROM GROUND TRACK**

Oklahoma City Area

February-July 1964

A. Median Overpressures

<u>Time Period</u>	<u>No. Weeks</u>	<u>Miles from Ground Track</u>		
		<u>0-8</u>	<u>8-12</u>	<u>12-16</u>
		<u>Overpressure (PSF)</u>	<u>Overpressure (PSF)</u>	<u>Overpressure (PSF)</u>
Feb. 3-April 19	11	1.13	0.80	0.65
April 20-June 14	8	1.23	1.10	0.85
June 15-July 25	6	1.60	1.35	1.00

B. Frequency of Occurrence of Programmed Overpressure Levels (PSF)

<u>Time Period</u>	<u>Weeks</u>	<u>Miles from Ground Track</u>					
		<u>0-8</u>		<u>8-12</u>		<u>12-16</u>	
		<u>1.5(PSF)</u>	<u>2.0(PSF)</u>	<u>1.5(PSF)</u>	<u>2.0(PSF)</u>	<u>1.5(PSF)</u>	<u>2.0(PSF)</u>
Feb. 3-Apr. 19	11	16%	2%	6%	1%	2%	0%
April 20-June 14	8	30	9	25	8	10	2
June 15-July 25	6	60	22	40	15	21	7

IV. PERSONAL INTERVIEW FINDINGS

A. Number and Type of Interviews

Completed Interviews: The actual number of interviews completed in this study is summarized in Table 3. Almost 3000 adults were interviewed in all three time periods. About 300 persons who were interviewed in the first period were away, moved or could not be reached during the second or third time periods. Very few actually refused to be interviewed. An analysis of the initial responses of these 283 incomplete interviews reveals no significant differences from the answers of the 2852 complete interviews, indicating that very little bias was introduced by failure to secure these missing interviews.

Face-to-face and telephone interviews: It will also be noted that 745 of the first interviews were conducted by telephone and 2390 face-to-face. A careful comparison of answers by these two groups indicates no significant differences in response. Consequently, these two groups are merged in the tables that follow.

Urban-rural interviews: It is also of interest that a systematic study of answers by comparable urban and rural residents reveals no significant differences with regard to the sonic boom reactions. Consequently, these groups are also combined for the summary presentation of findings.

Control over bias in repeated interviewing: During the second and third interview periods different independent random samples of about 200 adults were interviewed each time to test for possible interview effects. The fact that each respondent had already been interviewed could affect his second and third interview responses. A careful comparison of answers reveals no significant differences between the regular sample and the special control samples, thus further supporting our confidence in the regular survey findings.

Importance of public information: One other characteristic about the sample of respondents is important for consideration before findings are presented. Extensive local and national publicity openly stressed that the sonic booms were part of a test of human tolerance of the booms. It was further emphasized that a major consideration in whether the government would support the continued development of an SST was whether the local population indicated it could accept the booms. Soon after the start of the booms, some groups organized to stop the booms and to encourage complaints, while others urged acceptance of the booms and sought to discourage complaints.

Controlling for possible bias: It has been found in other research that when respondents are aware of the purposes of the interview and feel that their answers may affect some administrative actions in which they have a personal interest, there is the possibility that answers will be slanted by the respondents to achieve the desired administrative actions. Since the object of this research was not to measure the biases of Oklahoma City residents per se, but to try to use their answers as representative of other communities in the United States, a special effort was made to measure and control for these possible biases. Special questions were included in the interviews to measure the extent to which respondents actually were aware of the purposes of the sonic

booms, had heard of the NORC study, were connected with the FAA or the aviation industry, and whether or not they felt people should complain about the booms if they were annoyed by them.

Heard of purposes: Almost 70% of all residents said they were aware of the purposes of the sonic boom tests at the time of the first interview. This knowledge did result in initially reported higher acceptance of the booms, but by the second and third interviews, the reported acceptance rates were about the same.

Heard of NORC study: Only 5% of the respondents said they knew about the NORC study before they were interviewed. Such a small knowledgeable group could not greatly bias the overall findings, and it can be concluded that the public release of an announcement about NORC did not greatly affect the study.

Direct connections to the aviation industry: About one-third of all residents had direct ties with the aviation industry, but such connections do not appear to have biased reactions to the sonic booms. Those with direct ties were more knowledgeable about the purposes of the tests, but were about the same as persons with no aviation connections with respect to other major sonic boom attitudes and reactions. About the same proportions felt people should complain about booms if annoyed (71% vs. 72%). Likewise, almost equal numbers believed the SST was important (65% vs. 62%), and that local booms were necessary (45% vs. 42%). Finally, at the end of the study, almost the same numbers reported annoyance with the booms (53% vs. 50%).

Belief in appropriateness of complaint: About 29% of all residents felt it was improper for a person to complain even if he was annoyed. Such an attitude casts suspicion on the validity of such a person's own interview responses on sonic booms. There is a strong possibility that negative reactions which may be felt are not reported. This seems to be the case, since reports of interference, annoyance, desires to complain are lower for persons who feel complaining is improper than for those who feel people should complain if annoyed. Consequently, to remove the possible bias from the major findings, it was decided to eliminate the answers of these biased respondents from the analyses of this report, but to include them as a separate group in the more comprehensive part II of the full report. Thus, the major findings are confined to reports by 2033 respondents.

Table 3

INTERVIEWS COMPLETED

Oklahoma City Area

February-July 1964

	<u>Totals</u>
First interviews completed.	3135
Face to face	2390
Telephone.	745
Less: Incompletes-Second Interview.	- 125
Face to face	96
Telephone.	29
Second interviews completed	3010
Less: Incompletes-Third interview	- 158
Fact to face	122
Telephone.	36
Third interviews completed.	2852
Plus: Control sample-second interview	197
Control sample-third interview.	199
Total interviews completed.	9393

B. Some Basic Characteristics of the Oklahoma City Area

Local Problems: In order to judge fairly the reactions to sonic booms, it is necessary to get a brief overall picture of Oklahoma City's general attitudes and actions with respect to all kinds of local problems. In general, local residents have a high attachment to their communities. Over 8 out of 10 rate their area as an excellent or good place to live, with almost half giving an excellent rating. Only 3 out of 100 report many things they dislike about their residential environments. When asked to name the one thing disliked most, traffic danger was reported most frequently by 12.4% of all persons, with almost an equal number (12.0%) spontaneously mentioning sonic booms. Third in importance was inadequate transportation, mentioned by 8.6% of all residents. Almost one-third refused to mention any serious dislike, so that of those actually mentioning a serious dislike, almost one in five mentioned sonic booms.

General pattern of complaining: Few people in Oklahoma City feel like complaining when they believe they have a local problem. When those residents mentioning the one thing disliked most were asked if they ever felt like doing anything about their serious dislike, only 28% said they felt like doing something; 72% were completely passive.

As expected, even fewer, or only 10%, said they actually followed through and wrote or telephoned an official, and only about 5% signed a petition. As we shall see in Table 10, this low general complaint potential or desire to complain, partially explains the level of complaints about booms. A further explanation of low complaints is revealed by the feeling of futility about complaining. Only four out of 100 felt the chances of doing something about their problem were "very good," while only an additional eight out of 100 said the chances were even "good."

C. Reported Overall Reactions to Sonic Booms in Oklahoma City Area

Special problems in middle distance areas: Before discussing the findings a further word of explanation should be made about the 8-12 mile distance group. While over 90% of those residing in the 0-8 mile zone also work in the same close zone, only 54% of the 8-12 mile residents also work in the middle zone. Most of the others who live in the middle zone work in the close, 0-8 mile zone. An analysis of responses showed the cross-zone commuters had a higher annoyance and complaint response than the "stay-at-home" workers and this was obscuring differences between the 0-8 and 8-12 mile zones. Consequently, in computing the total responses for the area, all persons answering boom questions are included, but in showing differences by miles from ground track only those persons who work and reside in the middle zone are included. As a result the number of respondents for the three distance zones do not add to the total number of respondents. A fuller picture of all respondents will be shown in part II of the report.

1. Reports of Interference

As already mentioned, all respondents were divided into three groups according to the distance of their homes from the ground track. Table 3 showed the actual differences in the physical overpressure levels of the sonic booms in these distance groups. Table 4 shows the corresponding reports of interference by the booms.

Table 4

REPORTED TYPES OF INTERFERENCE BY SONIC BOOMS
BY DISTANCE FROM GROUND TRACK

Oklahoma City Area
February-July 1964

Type of Interference	Miles from Ground Track											
	Total*		0 - 8				8 - 12				12 - 16	
	2/3- 4/19	4/20- 6/14	6/15- 7/25	2/3- 4/19	4/20- 6/14	6/15- 7/25	2/3- 4/19	4/20- 6/14	6/15- 7/25	2/3- 4/19	4/20- 6/14	6/15- 7/25
Number of respondents	2019	2026	1915	1037	1045	989	551	351	331	336	335	314
House rattles	89%	89%	94%	89%	90%	95%	91%	85%	92%	86%	83%	79%
Startles	39	35	38	40	36	40	38	32	33	29	25	25
Interrupts sleep	14	15	18	15	17	19	13	7	11	6	9	9
Interrupts rest	11	12	17	11	13	18	12	10	14	6	7	9
Interrupts conversation .	9	12	14	9	11	14	11	10	12	5	11	6
Interrupts radio-TV . . .	7	8	9	7	9	9	7	5	7	4	5	5

* Includes only persons who feel people should complain if annoyed.

Types of interference: Some interference is reported by practically all residents. Almost 9 out of 10 persons report house rattles and vibrations as the most frequent interference caused by booms. Being startled is next in importance, followed by sleep, rest interference and communications interference. Overall, reports of house rattles remains fairly stable during the first two time periods, especially in the close areas, but rises a little during the third and final interview period. Only in the distant areas are 4% less house rattles reported during the final interview. It should be noted that more sleep and rest interruptions are also reported at the end of the study than at the beginning.

Distance groups: While the responses by the first and second distance zones were not greatly different during the first interview, at the time of the third interview, when the actual differences in sonic boom levels were greater, the first zone residents clearly reported more interference than the middle or distant areas. The distant 12-16 mile group consistently reported less interference than the other distance groups, forming a gradient of response with the most intense interference reported by the closest areas and the least interference reported by the farthest areas.

2. Reports of Annoyance

Intensity of annoyance: Most residents are not seriously annoyed by the booms. Only those people reporting "more than a little annoyance" are included as significantly or seriously annoyed. An additional 21% report a "little" annoyance with house rattling and another 10% report a "little" annoyance with being startled. To be conservative in our projections, however, these little annoyance reports are excluded from Table 5 as not very serious.

Type of interference: Only about one in three persons who report house rattles in the first interview period, also report more than a little annoyance with this interference. About half of those who report being startled in period one, however, report more than a little annoyance. If people also report other kinds of interference, most of them also consider it a serious annoyance. The rank ordering of annoyances is the same as for the interferences, with one-third reporting serious annoyance with rattles, followed by one-fifth annoyed by being startled, and less than 10% reporting annoyance with sleep or rest interference, and 5% with interruption of conversation or radio and TV listening.

Intensity of booms: Annoyance increased steadily over the six month period. While reported interferences were stable during the first two periods and increased only a little in the last period, annoyance increases steadily from the first to the third interview. At the final interview over half of all persons were more than a little annoyed by house rattles, and 28% with being startled. This is believed primarily due to the increase in intensity of the booms.

Distance groups: Annoyance reports of the middle distance group are only a little less than the close areas during the first interview, but the differences become significantly greater during the second and third periods. In all periods, the most distant areas report less annoyance than the close or middle areas, thus forming a gradient of annoyance response by distance from ground track. It should be noted that even in the distant areas annoyance increases over time as the intensity of the boom increases.

Table 5

REPORTED MORE THAN A LITTLE ANNOYANCE
BY TYPE OF INTERFERENCE AND DISTANCE FROM GROUND TRACK

Oklahoma City Area
February-July 1964

Type of Interference	Miles from Ground Track											
	Total*			0 - 8			8 - 12			12 - 16		
	2/3- 4/19	4/20- 6/14	6/15- 7/25	2/3- 4/19	4/20- 6/14	6/15- 7/25	2/3- 4/19	4/20- 6/14	6/15- 7/25	2/3- 4/19	4/20- 6/14	6/15- 7/25
Number of respondents	2019	2026	1915	1037	1045	989	351	351	331	336	335	314
House rattles.	33%	44%	54%	34%	46%	56%	30%	36%	46%	20%	31%	35%
Startles	20	22	28	20	23	29	18	18	20	9	13	16
Interrupts sleep	9	11	14	9	12	16	8	5	8	3	5	7
Interrupts rest.	8	11	14	8	11	15	7	10	11	4	5	8
Interrupts conversation.	5	7	10	4	7	10	5	6	8	2	6	5
Interrupts radio-TV. . . .	4	5	6	4	6	6	3	3	6	1	2	5

* Includes only persons who feel people should complain if annoyed.

Interference and annoyance: Interference and annoyance reports are graphically presented in Table 6. Interference is defined as the most frequently mentioned activity which is interfered with, namely house rattle; while annoyance is defined as more than a little annoyance with any type of interference. As can be seen, reports of interference are always much greater than annoyance, although the proportion of annoyance to interference increases steadily over time. At the final interview, 58% of all close area residents report more than a little annoyance with booms.

Comparison of annoyance under equal boom intensity: As reported earlier in the discussion of Table 2, the actual boom levels for the following groups were comparable: the 0-8 mile group during the first period; the 8-12 mile group during the second period, and the 12-16 mile group during the third period. If we compare the annoyance levels of these groups we find all practically alike -- 38% for the 0-8 mile group, compared to 37% for the middle distance, and 38% for the distant group. Likewise the boom level of the 0-8 mile group during the second period was almost the same as the intensity of booms in the middle distance during the third period, and a glance at Table 6 reveals that 46% in both groups report more than a little annoyance. These comparisons suggest that most of the increase in annoyance over time is primarily due to the increase in boom levels rather than to cumulative growth in annoyance with the same booms.

3. Reports of Damage by Sonic Booms

Extent of alleged damage: One of the most important variables influencing people's annoyance and complaint potential appears to be their belief that sonic booms have damaged their homes. The relationship of such reports of damage and annoyance and complaints will be shown later. Table 7 merely shows the numbers of people who feel that some damage has resulted from the booms. Overall almost four out of 10 feel they sustained some damage from the booms during the six month period. About half of these people reported damage occurring only once during the study; 6% during the first period, another 6% during the second period, and 8% during the last period. Seven percent felt they had sustained damage during all three periods and another 11% felt they had experienced damage during two of the three periods. The number reporting alleged damage during each interview remained about the same, 2-3%.

As can be seen in Table 7, the three distance zones form a gradient of damage reports, with 46% reporting some damage in the close areas, 36% in the middle distance and only 17% in the distant 12-16 mile zone.

Actual reports of damage to FAA: It should also be emphasized that only a fraction of those who felt their property had been damaged by the booms actually reported it to the FAA center. Roughly, only one in eight persons who reported damage on the interview, actually informed the FAA of their alleged damage. In part this low level of follow-through may be due to the widespread ignorance of where to complain. In answer to a direct question, "Do you happen to know where to call if you want to complain about the booms?" only 30% actually knew where to call. Another possible reason may have been the feeling that the amount of effort required to complain was greater than the possibilities of achieving something useful.

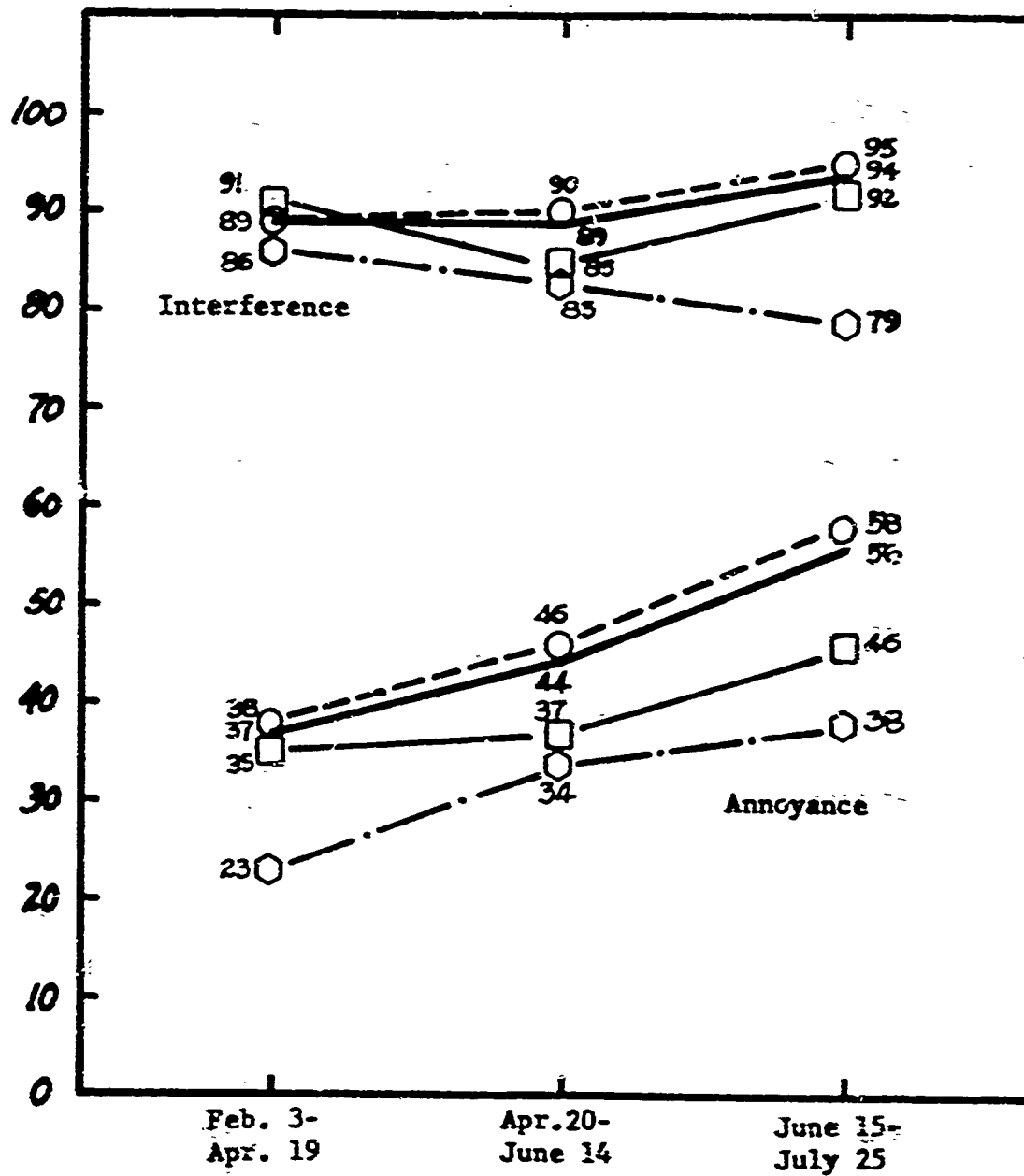
Table 6

REPORTED INTERFERENCE AND ANNOYANCE BY SONIC BOOMS

Oklahoma City Area

February-July 1964

Percent
Reporting



— Total
 ○ --- 0-8 miles
 □ — 8-12 miles
 ○ -.- 12-16 miles

Table 7

NUMBER OF REPORTS OF DAMAGE BY SONIC BOOMS
BY DISTANCE FROM GROUND TRACK

Oklahoma City Area

February-July 1964

Number Damage Reports	Miles from Ground Track			
	Total*	0 - 8	8 - 12	12 - 16
Number of respondents	2033	1048	352	337
Three.	7%	8%	8%	1%
Two.	11	15	7	5
One.	20	23	21	11
Some.	38	46	36	17
None.	62	54	64	83

* Includes only persons who feel people should complain if annoyed.

4. Reports of desires to complain and actual complaints about sonic booms

Desire to complain: Each respondent was asked directly whether or not he even felt like doing something to stop or reduce the booms. Only 16% overall felt like doing something in the first period. This rose to 23% during the second interview and remained at 22% during the final interview. Thus, while about 60% were more than a little annoyed at the end of the study, only about one in three annoyed persons felt like complaining; or to put it another way, for every person who felt like complaining, there were two others who were significantly annoyed and did not feel like complaining.

Actual complaints: As we shall see in Table 10, only one out of four who felt like complaining actually did, or in terms of annoyance, only one in 12 who was seriously annoyed actually complained. This ratio enables the administrator to gauge the size of the "silent annoyance" from the number who actually registered complaints. Table 8 summarizes the readiness of residents to complain about the booms, or the complaint potential.

Distance areas: As can be seen in Table 8, the areas close to the flight track report the highest desires to complain followed in order by the middle and distant areas. This pattern is consistent with the gradient of responses already reported on interference and annoyance.

Calls to FAA: Very few residents actually called the FAA complaint center. Less than five out of every 100 residents said they called the FAA at some time during the study. The closest areas report the highest actual complaints, followed by the middle and distant areas. About 20% of all complainers said they called more than once and this tallies with an independent analysis of actual complaints received by the FAA center. In fact, if the complaint rates reported in Table 9 are extrapolated to the total estimate of 179,000 families living in the Oklahoma City area affected by the booms, the estimate of total calls amounts to about 13,000 calls compared to the actual recorded number by FAA of 12,400. This close agreement further confirms the accuracy of the interview reports. Table 9 presents a summary of actual reported complaints.

Boom complaints compared to general complaints: The magnitude of the sonic boom complaints should be compared to the general level of complaining about any serious local problem in order to achieve a valid perspective. Table 10 graphically presents these comparisons. As described previously in Section B, only 28% of those with a serious problem generally felt like doing something about it, and only 10% actually followed through -- a ratio of 1:3, actual to potential behavior. In the case of booms, 22% (a little less than the general level) felt like complaining, while only 5% actually did, a ratio of about 1:4, actual to potential. Thus we see the complaint behavior about booms is somewhat less than the generally expected complaint level in the Oklahoma area. By distance groups, the relation of actual boom complaints to potential is highest in the close areas, about 1:4, dropping to 1:5 in the middle area and to 1:11 in the distant areas.

5. Long Range Acceptability of Sonic Booms

Knowledge of test duration: The FAA boom test was publicized as a six month program, and almost four out of 10 actually knew this duration at the first interview. Almost all respondents knew that the booms would end after July, when asked about it on the last interview. Since the SST in actual commercial use would be expected to fly indefinitely, a question was added toward the end of each interview to measure expectations of indefinite boom exposure and self-appraisals of adaptation.

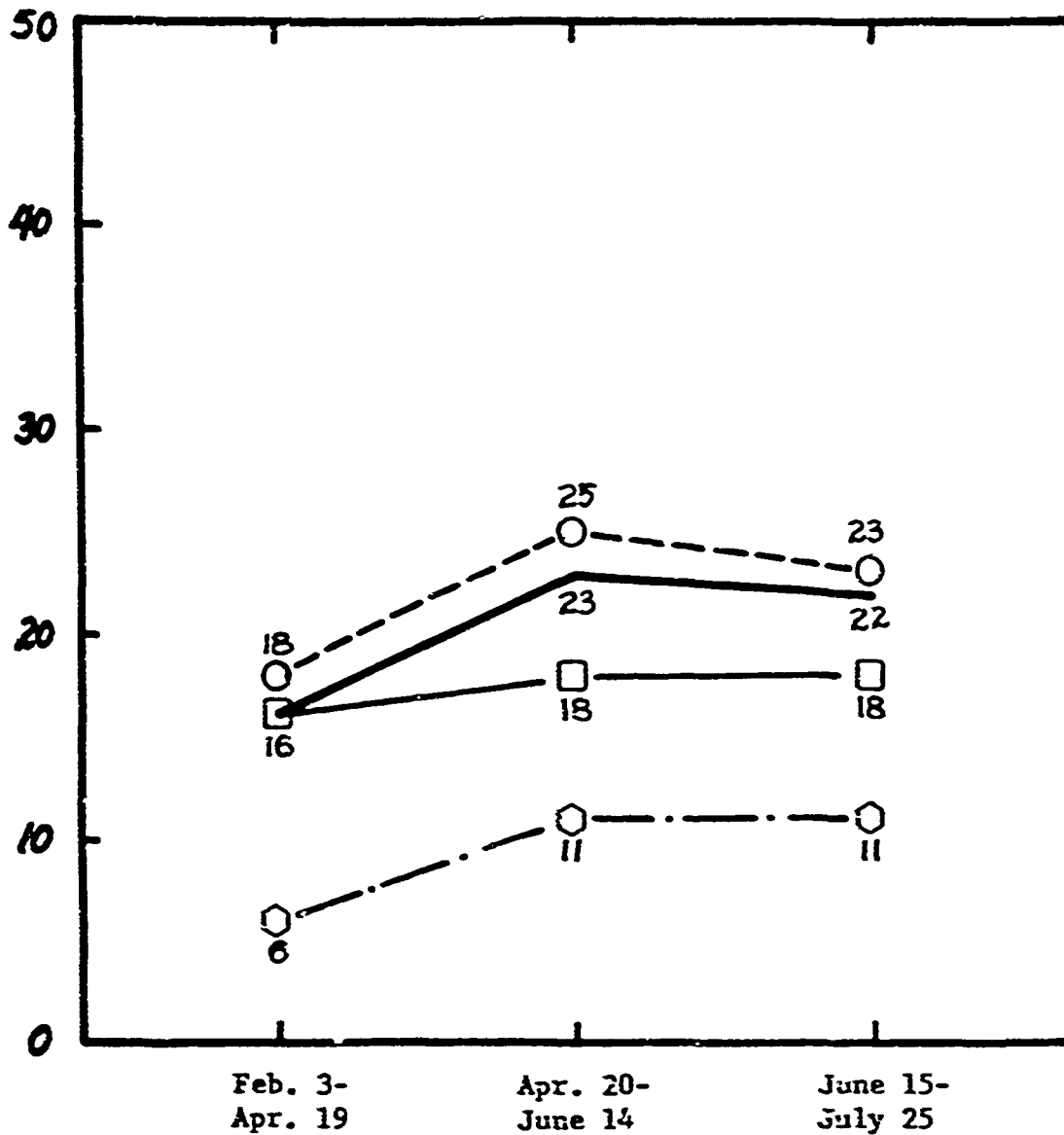
Table 8

COMPLAINT POTENTIAL FOR BOOMS - PERSONS FELT LIKE COMPLAINING

Oklahoma City Area

February-July 1964

Percent
Felt Like
Complaining



— Total
○--- 0-8 miles
□— 8-12 miles
⬡-.- 12-16 miles

Table 9

NUMBER OF ACTUAL REPORTED COMPLAINTS ABOUT BOOMS
BY DISTANCE FROM GROUND TRACK

Oklahoma City Area

February-July 1964

Number Actual Complaints	Miles from Ground Track			
	Total*	0 - 8	8 - 12	12 - 16
Number of respondents	2033	1048	648	337
Three.7%	1.0%	.3%	.3%
Two.	1.2	1.7	.6	.3
One.	3.0	3.8	3.1	.6
Some -	4.9	6.5	4.0	1.2
None -	95.1	93.5	96.0	98.8

*Includes only persons who feel people should complain if annoyed.

Table 10

COMPARISON OF GENERAL AND BOOM COMPLAINT POTENTIALS

Oklahoma City Area
February-July 1964

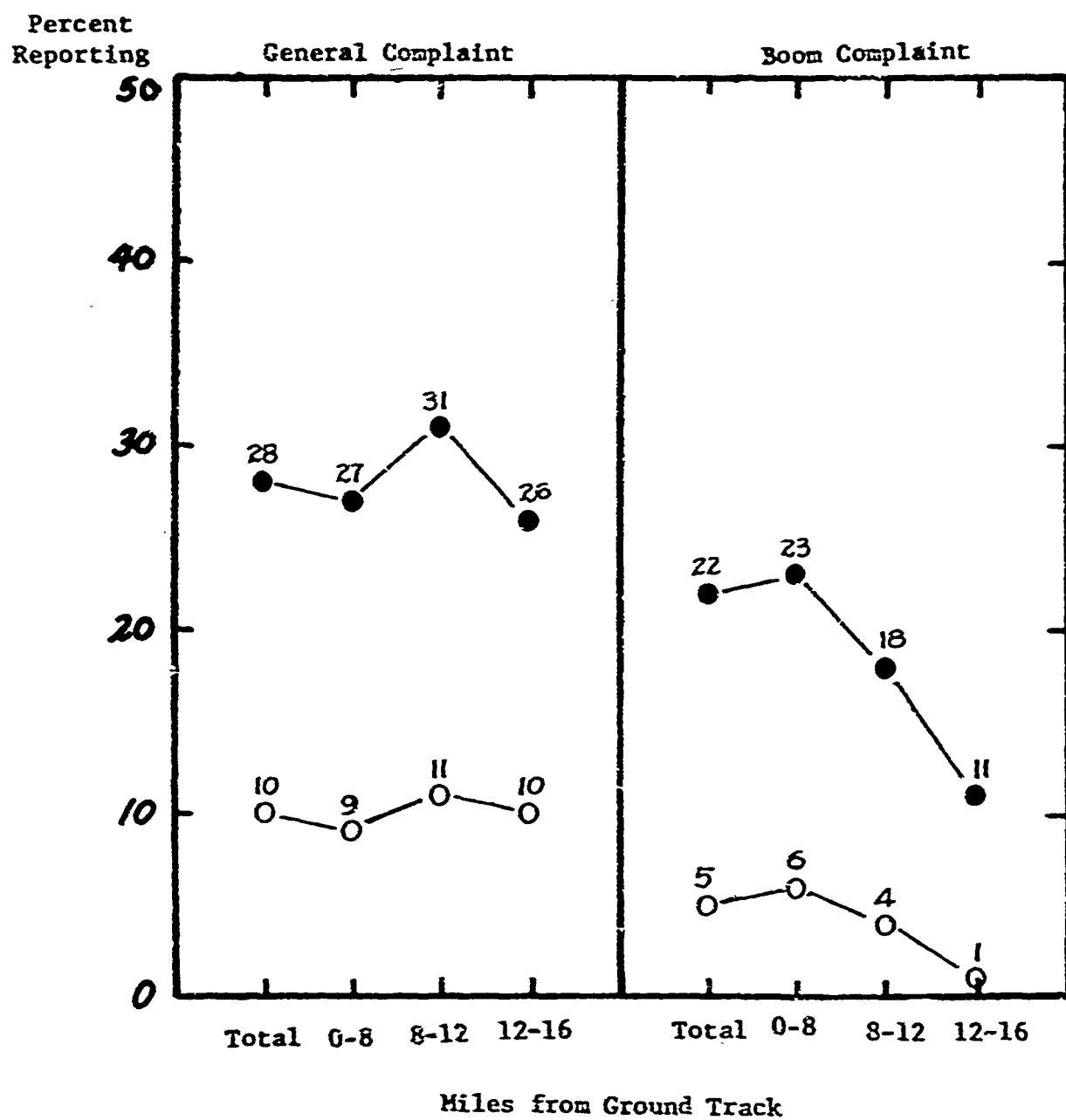
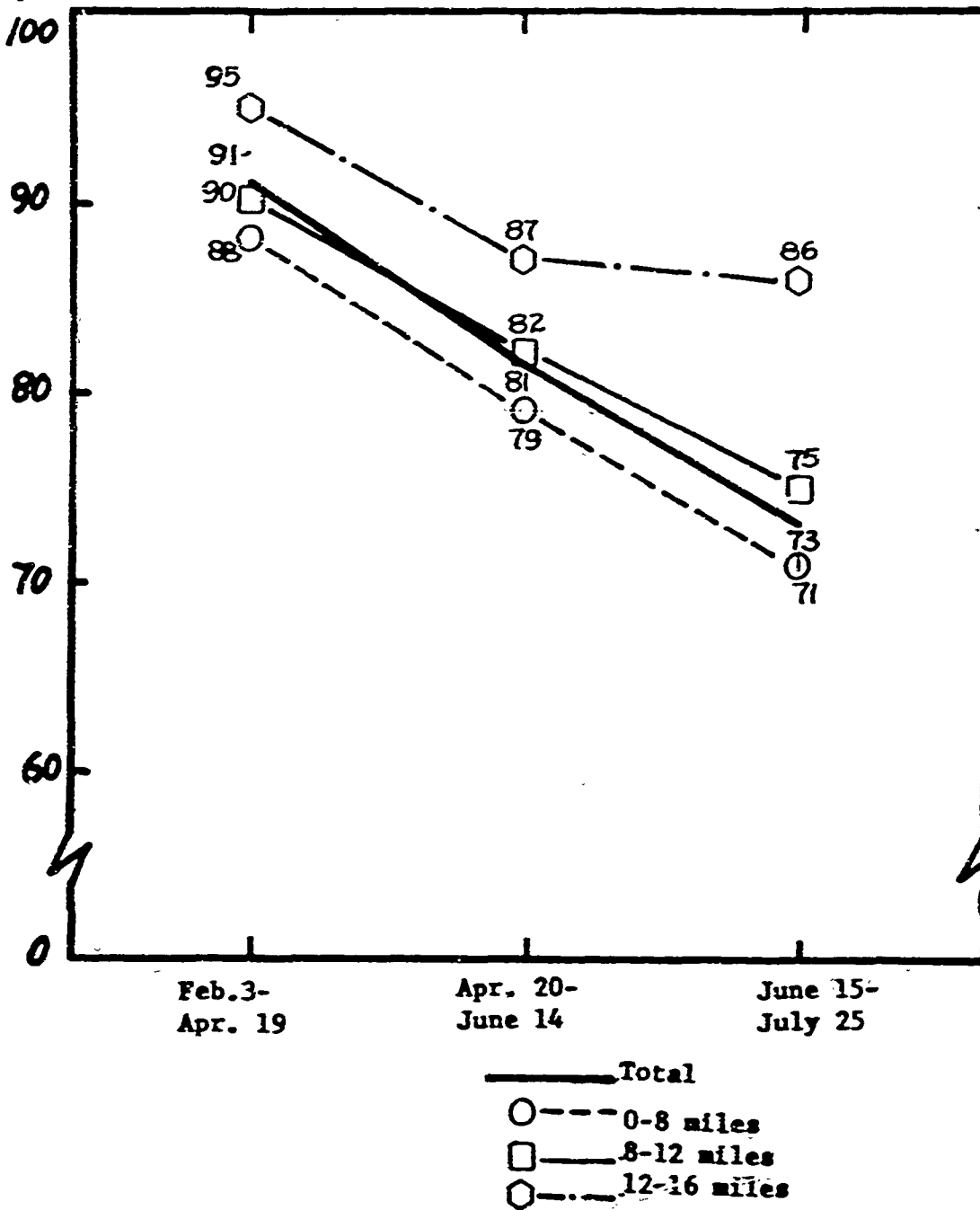


Table 11

REPORTED ABILITY TO ACCEPT EIGHT BOOMS PER DAY

Oklahoma City Area
February-July 1964

Percent
Very Likely
or Might Accept



Trend in acceptability: Expectation of adapting to the booms declined as ~~the intensity of the booms increased during the six month period.~~ While overall 91% felt they very likely or might accept eight booms a day like those experienced during the first interview, this rate drops to 81% during the second interview and 73% during the final interview. Thus, over one out of every four residents felt he could not put up with eight 1.5 PSF booms per day (scheduled at 2.0 PSF).

Distance areas: The gradient of response by distance group is seen again with 86% of the 12-16 mile group compared to 71% of the closest 0-8 mile group reporting ability to accept the 1.5 PSF booms.

In the succeeding sections the importance of several intervening variables on boom reactions will be discussed. These variables are subject to change by administrative programs and success in appropriate administrative actions could significantly increase the acceptability of sonic booms.

D. Effects of Belief in Importance of a Supersonic Transport and Feelings About the Absolute Necessity of Having Local Booms on Reactions to Sonic Booms

Approach for projection of Oklahoma City responses: The previous section presented the overall reactions of Oklahoma City residents to the sonic booms. Not all Oklahoma City residents obviously felt alike or reacted the same way toward the booms. Some of their attitudes tended to increase acceptability of booms and others tended to decrease adjustment toward the booms. A knowledge of those variables which facilitate adjustment will be helpful to SST managers in projecting the Oklahoma City overall responses to other communities throughout the United States. The particular combination of favorable and unfavorable attitudes will not be the same in all communities, and by knowing the range in reactions related to these attitudes, the effects on sonic boom reactions can be estimated from new combinations of basic attitudes. The range in reactions also suggest the expected maximum and minimum levels of reaction to the booms.

Two basic attitudes: The two attitudes which will be discussed first are belief in the absolute necessity of having an SST and belief that local booms are unavoidable and necessary in Oklahoma City. These attitudes, which might be influenced by proper public information programs, are extremely important in influencing reactions of annoyance, complaint, and long range acceptability of booms. In the tables that follow, it will be shown that favorable attitudes toward the SST and local booms establishes a minimum expected level of community annoyance and complaint, while negative attitudes set a maximum level of non-acceptability.

The overall Oklahoma City reactions discussed above are a product of generally favorable attitudes of a given magnitude found among local residents. With even more successful public information programs directed to more specific goals, however, an even more favorable overall response might be expected.

Importance of SST: Toward the end of the first interview all persons were asked, "As you probably know the recent booms around here are part of a government development program of a new airplane that will fly about 2000 miles an hour. Do you feel it is absolutely necessary for our country to have such a civilian plane, do you feel it is probably necessary, or do you feel it is not necessary?" About a third of all people in Oklahoma City felt it was absolutely necessary, an almost equal number felt it was probably necessary, and a like

~~number that it was not necessary or did not know if it was necessary.~~ Thus two out of three were favorably disposed to the SST.

All those who did not answer absolutely necessary, were also asked the following question, "As you may know, the French, British, and the Russians are already building a commercial supersonic airplane. If these countries have such a plane, would you feel it absolutely necessary for Americans to make one too, would it probably be necessary, or would it not be necessary?" About 60% felt it was absolutely necessary to have an SST in such circumstances, and an additional 22% thought it was probably necessary -- further revealing the favorable attitudes of local residents.

1. Feelings About the Necessity of Local Booms

Relationship of two attitudes: The striking relationship between a favorable attitude toward the SST and feelings about the necessity of local booms is shown in Table 12. As will be seen, the latter attitude is crucial in shaping tolerance of the boom.

Overall, the relationship of these attitudes is practically the same in all distance groups. About three-fourths of all persons who feel the SST is absolutely necessary also feel local booms are necessary (during the first interview). As the intensity of the booms increases, feelings about the necessity of local booms drops to 55%. Those who feel the SST is probably necessary start with 57% believing local booms are necessary and drop to 44% by the end of six months. In sharp contrast, those who feel the SST is not necessary or are uncertain of its necessity, only 29% say the local booms are necessary during the first interview and even less, only 19%, feel favorable about local booms at the end of July.

2. Reports of Annoyance

Range in annoyance: The combination of belief in importance of the SST and necessity of local booms provides the maximum favorable effect on annoyance with booms. Overall, and in each distance group, those who feel the SST is absolutely necessary and local booms are also necessary report the lowest annoyance. Conversely, those who feel the SST is not necessary and that local booms are not necessary report the maximum annoyance. For example, overall only 13% of those with the most favorable attitudes are more than a little annoyed during the first interview, increasing to only 25% at the end of the study. In contrast, those with the least favorable attitudes start with 57% more than a little annoyed and end with 76% more than a little annoyed (three times greater than the most favorable attitude group).

Distance areas: Even in the closest 0-8 mile group, those with the most favorable attitudes toward the SST and feelings about necessity of local booms report only 30% are more than a little annoyed at the end of the study compared to 81% for the least favorable attitude group. If more people can be convinced of the importance of the SST and of the unavoidability of local booms, the total annoyance undoubtedly would be reduced to close to the 25% level shown in Table 13.

Table 12

REPORTED BELIEF IN THE ABSOLUTE NECESSITY OF LOCAL BOOMS
BY BELIEF IN THE NECESSITY FOR DEVELOPING AN SST

Oklahoma City Area
February-July 1964

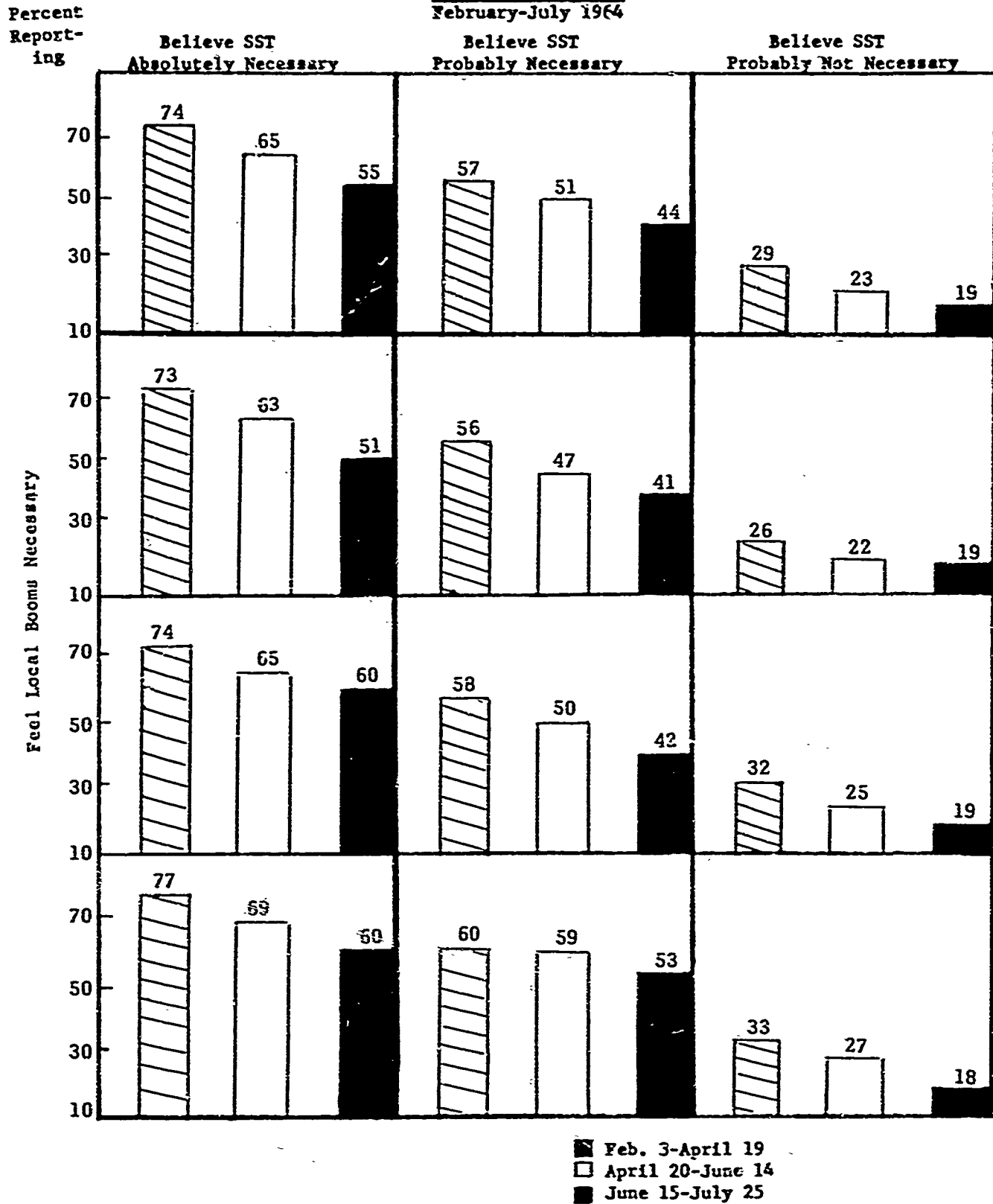
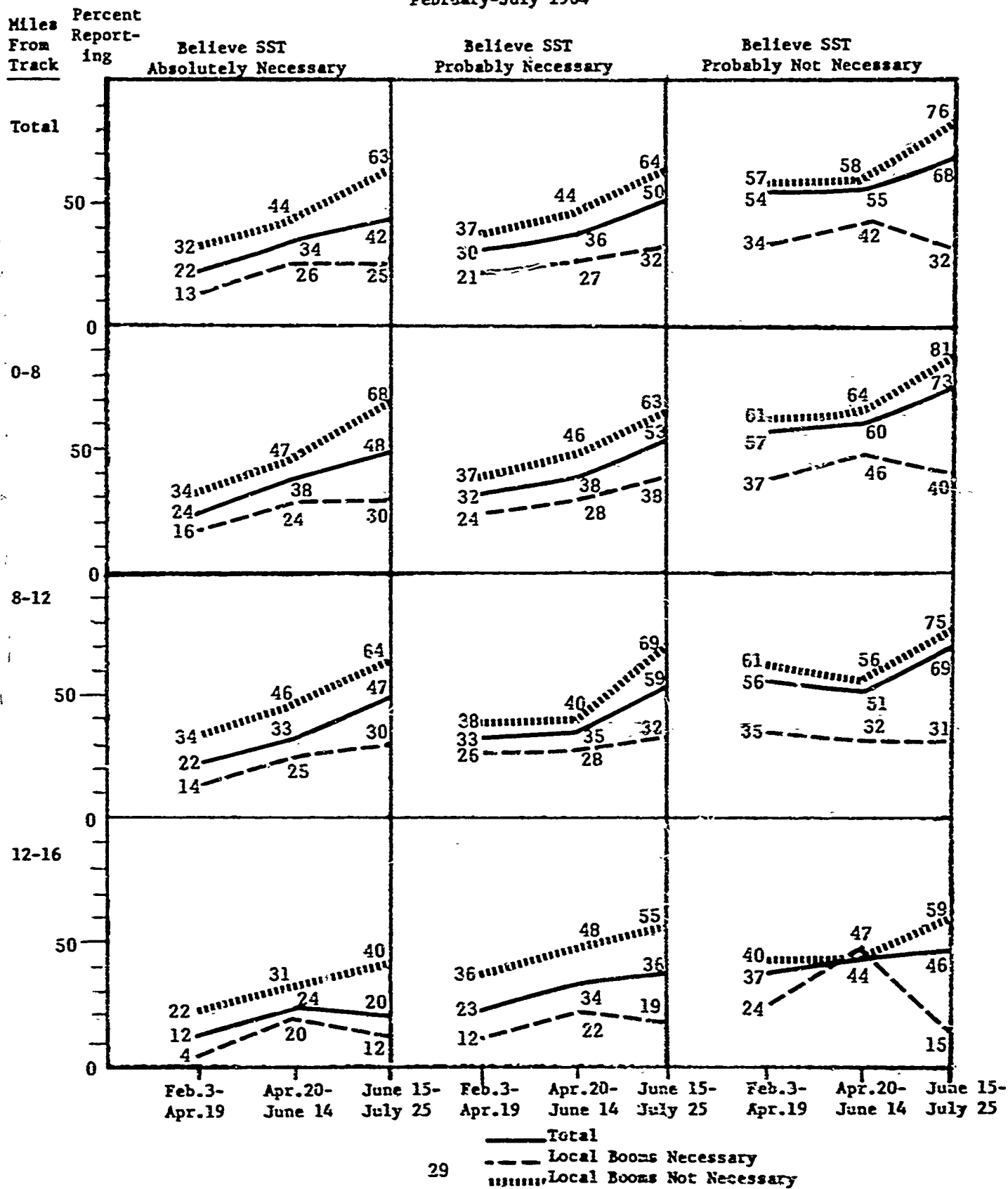


Table 13

REPORTED MORE THAN A LITTLE ANNOYANCE WITH BOOMS
BY BELIEF IN NECESSITY FOR DEVELOPING AN SST AND NECESSITY OF MAKING BOOMS LOCALLY
Oklahoma City Area
February-July 1964



3. Desires to Complain About Booms

Range in desire to complain: The relationship of these favorable attitudes and the complaint potential or desire to complain about the booms is shown in Table 14. The same pattern of reactions is observed. While the most favorable attitude group reports that only 2-4% even feel like complaining, the least favorable group reports 34-37% feel like complaining. In the closest, 0-8 mile group, the range for these contrasting groups at the end of the study is from 3% to 42%.

4. Long Range Acceptability of Sonic Booms

Range in acceptability: The long range expectations of adaptability to the booms follows a direct relationship to the favorable attitudes toward the SST and the local booms. The most favorable group more often feels they can live with the booms, while the least favorable less often say they can tolerate them. Table 15 presents this range of responses. While 92% of the most favorable group, at the end of the study feel they can live with the boom, only 57% of the least favorable say they can adapt to it.

Importance of necessity of local booms: As can be seen, the group which feels the absolute necessity of the SST is not too different from those who only feel the SST is probably necessary. Whether or not they feel local booms are necessary appears to be more important in influencing long range adaptation to booms. Of course, as we have seen, the extent to which the SST is considered necessary strongly influences feelings about the necessity of local booms. The next section will examine the effects of feelings about necessity of local booms and annoyance, complaints and long range adaptability.

5. Effects of Feelings about Necessity of Local Booms and "More Than a Little" Annoyance on Reactions to Booms

1. Reports of Annoyance

Trends in annoyance: Respondents were grouped into four basic categories to study the changes over time of basic boom effects. First, they were divided by whether or not they felt local booms were necessary at the end of the study, then they were subdivided further into whether or not they were more than a little annoyed by booms at the end of the study. Table 16 shows the trend in feelings of annoyance for these analytical groups.

Decreases in annoyance: Almost one in five respondents who were initially annoyed by the booms can be considered as having adjusted to them by the end of the study. Overall, if a person ends the study feeling that local booms are necessary and is not annoyed with the booms, then only 12% of these respondents report they were more than a little annoyed during the first interview, and 19% during the second interview.

Increases in annoyance: In contrast, of those who end up feeling local booms are not necessary and are annoyed, almost half were not annoyed at the first interview and became annoyed as the intensity of the booms increased.

Table 14

REPORTED COMPLAINT POTENTIAL WITH BOOMS

Oklahoma City Area
February-July 1964

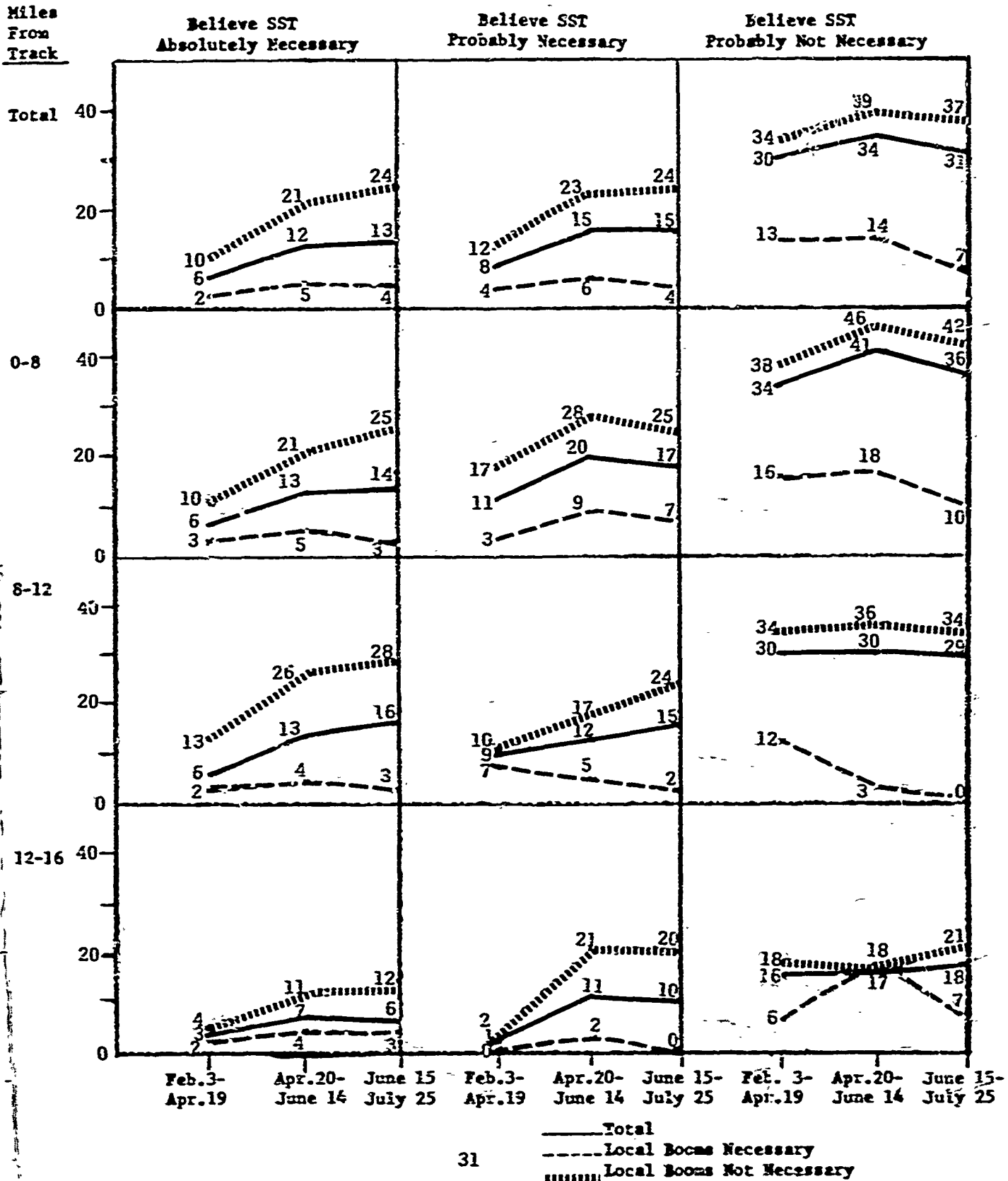


Table 15

REPORTED ABILITY TO ACCEPT EIGHT BOOMS PER DAY
BY BELIEF IN NECESSITY FOR DEVELOPING AN SST
AND NECESSITY OF MAKING BOOMS LOCALLY
Oklahoma City Area
February-July 1964

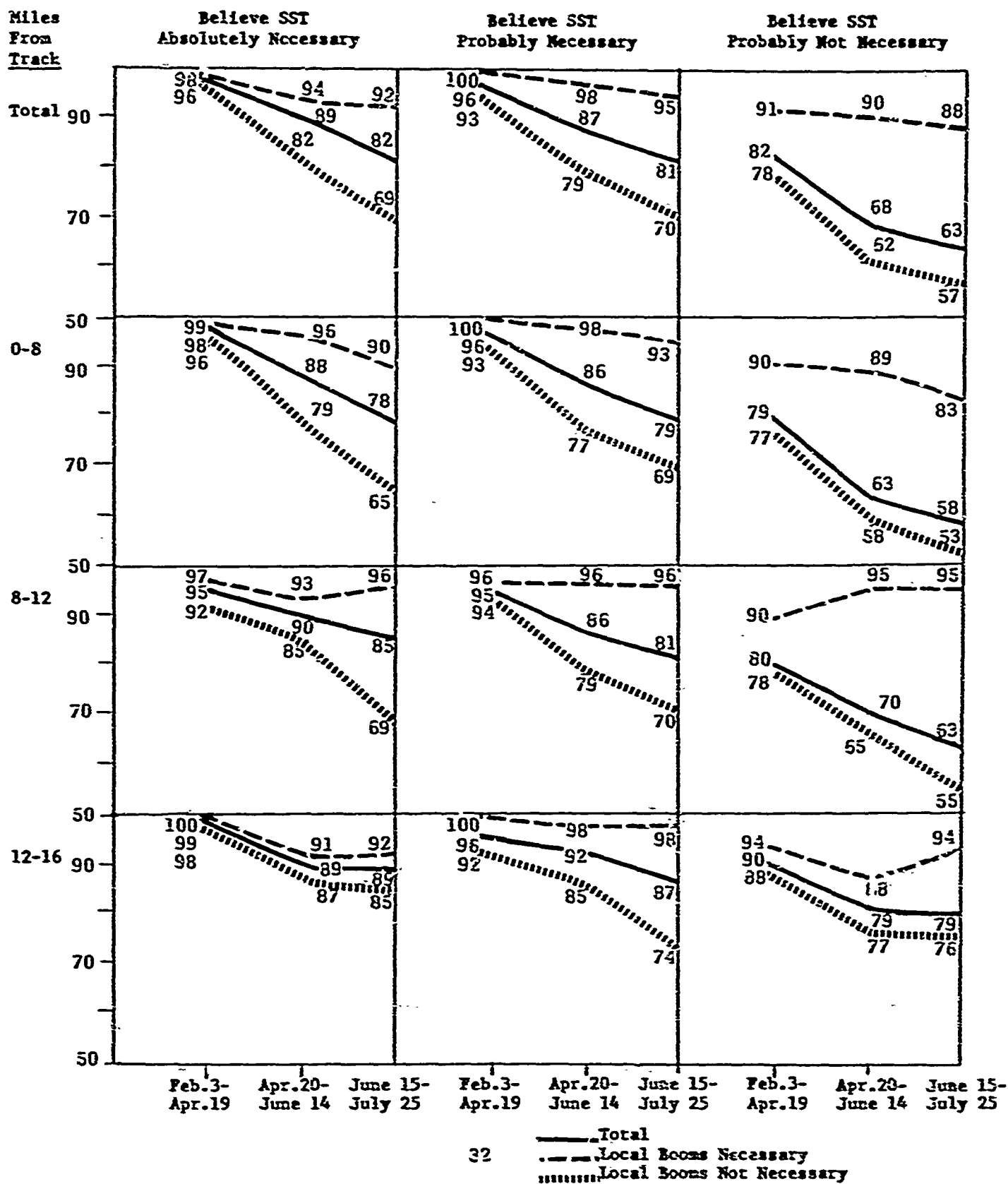
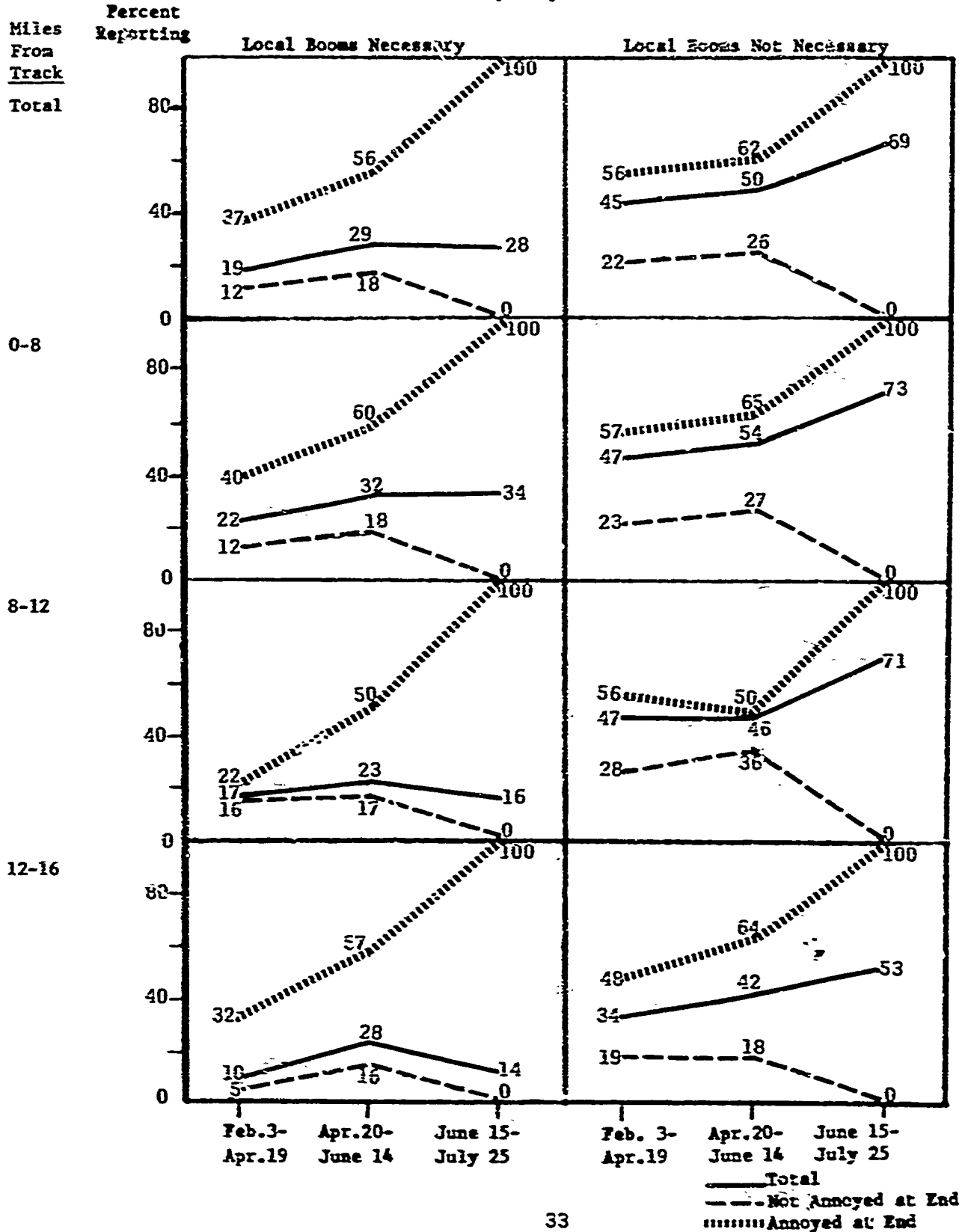


Table 16

REPORTED MORE THAN A LITTLE ANNOYANCE WITH BOOMS
BY FEELINGS OF NECESSITY AND ANNOYANCE WITH BOOMS AT END OF STUDY

Oklahoma City Area
February-July 1964



2. Desires to Complain

Range in complaints: A respondent who feels the booms are necessary also consistently is less likely to want to complain. If he also says he is not more than a little annoyed, in only 1% of the cases does he want to complain. In contrast, if he feels local booms are not necessary and is annoyed, his complaint potential rises from 28% to 41% at the final interview.

Distance areas: Differences by distance groups are much less than the variations among attitude groups. If a person is annoyed and feels that local booms are not necessary and lives in the distant areas, in 30% of the time he wants to complain, compared to 41% for the same type of person living in the close areas. Table 17 shows the relationship of the four attitude groups and desires to complain (complaint potential).

Actual complaints: Only 4% of the annoyed who live in close areas and felt the booms were necessary actually called the FAA, compared to 13% who were equally annoyed but did not feel the booms were necessary. Table 18 shows the actual reported complaint behavior of these four attitude groups.

3. Long Range Adaptability

Range in adaptability: A person who feels local booms are necessary even if annoyed, in at least 82% of the cases says he can live with the booms. In contrast, only 53% of annoyed persons who feel the local booms are not necessary say they can adjust to the booms. Table 19 graphically describes the changes in long range adaptability by these four groups.

Distance areas: In the 0-8 mile zone the range of these groups is 79% vs. 49%. If not annoyed, 97% who feel local booms are necessary say they can accept booms compared to 87% of those equally not annoyed but who feel local booms are not necessary. Note that the annoyed show a much sharper drop in acceptance of booms. Again note that the differences by distance groups are much less than the differences among attitude groups.

4. Reports of Damage

Range in damage reports: Those who feel local booms are necessary, in every case, less often report damage. Likewise, those who are not annoyed less often report damage. The combination of the two favorable attitudes is accompanied by the least amount of damage reports. Table 20 shows the strong relationship between feelings of having sustained damage and annoyance with booms and necessity of local booms.

Distance areas: In all cases, the close 0-8 mile group reports the most damage and the distant 12-16 mile group, the least. For example, two-thirds of those living in close areas who feel that local booms are not necessary and are annoyed report some boom damage. In contrast only 20% report damage although living in the same areas but who feel local booms are necessary and are not annoyed.

Influence of public information: It is possible that a thorough public information campaign could better inform people about what kinds of limited damage booms can actually be expected to produce. Such awareness could greatly reduce belief that booms cause damage, and thereby, further reduce antagonism to booms.

Table 17

COMPLAINT POTENTIAL FOR BOOMS
BY FEELINGS OF NECESSITY AND ANNOYANCE WITH BOOMS AT END OF STUDY

Oklahoma City Area
February-July 1964

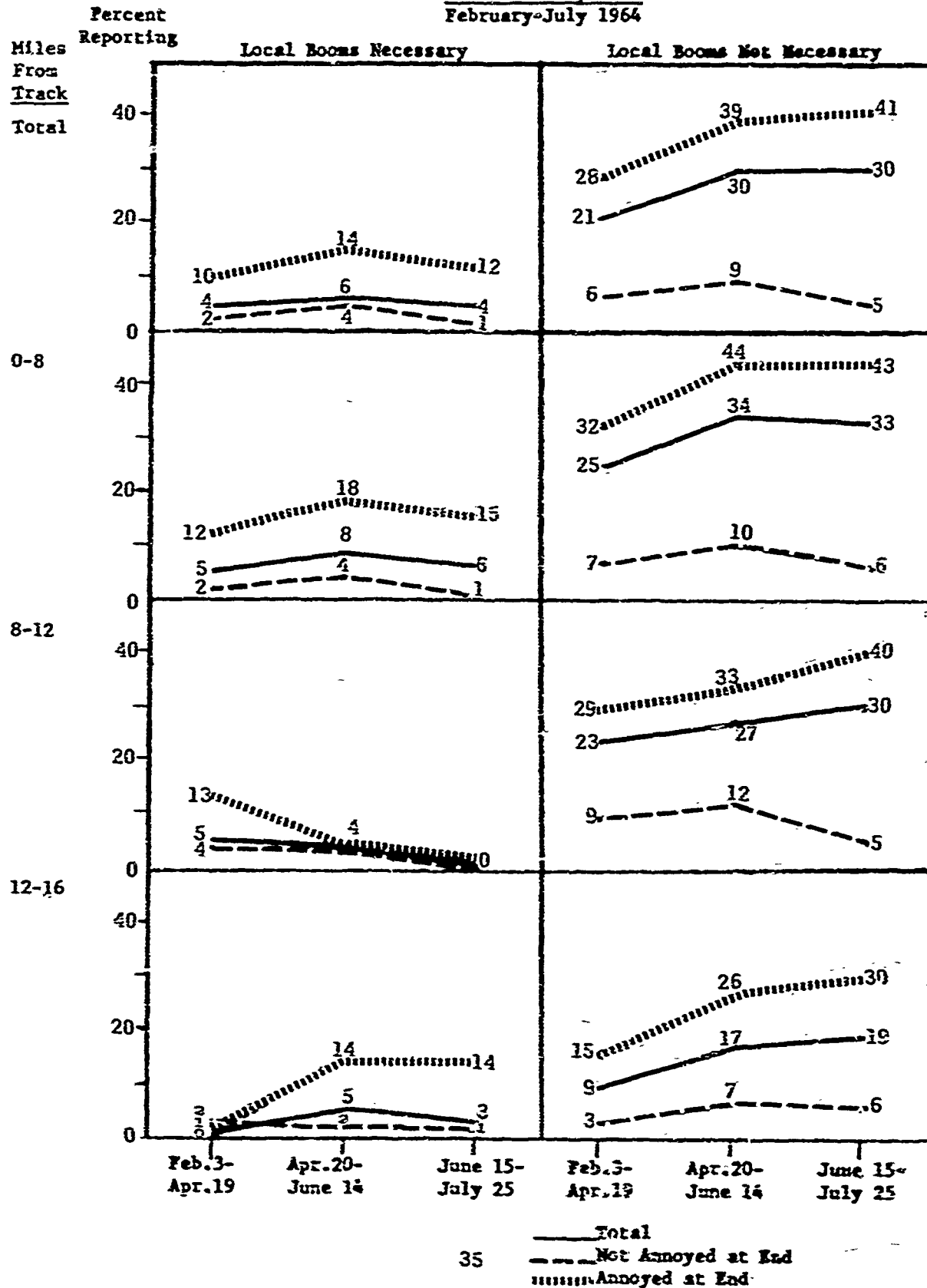


Table 18

ACTUAL COMPLAINTS ABOUT BOOMS
BY FEELINGS OF NECESSITY AND ANNOYANCE WITH BOOMS AT END OF STUDY

Oklahoma City Area

February-July 1964

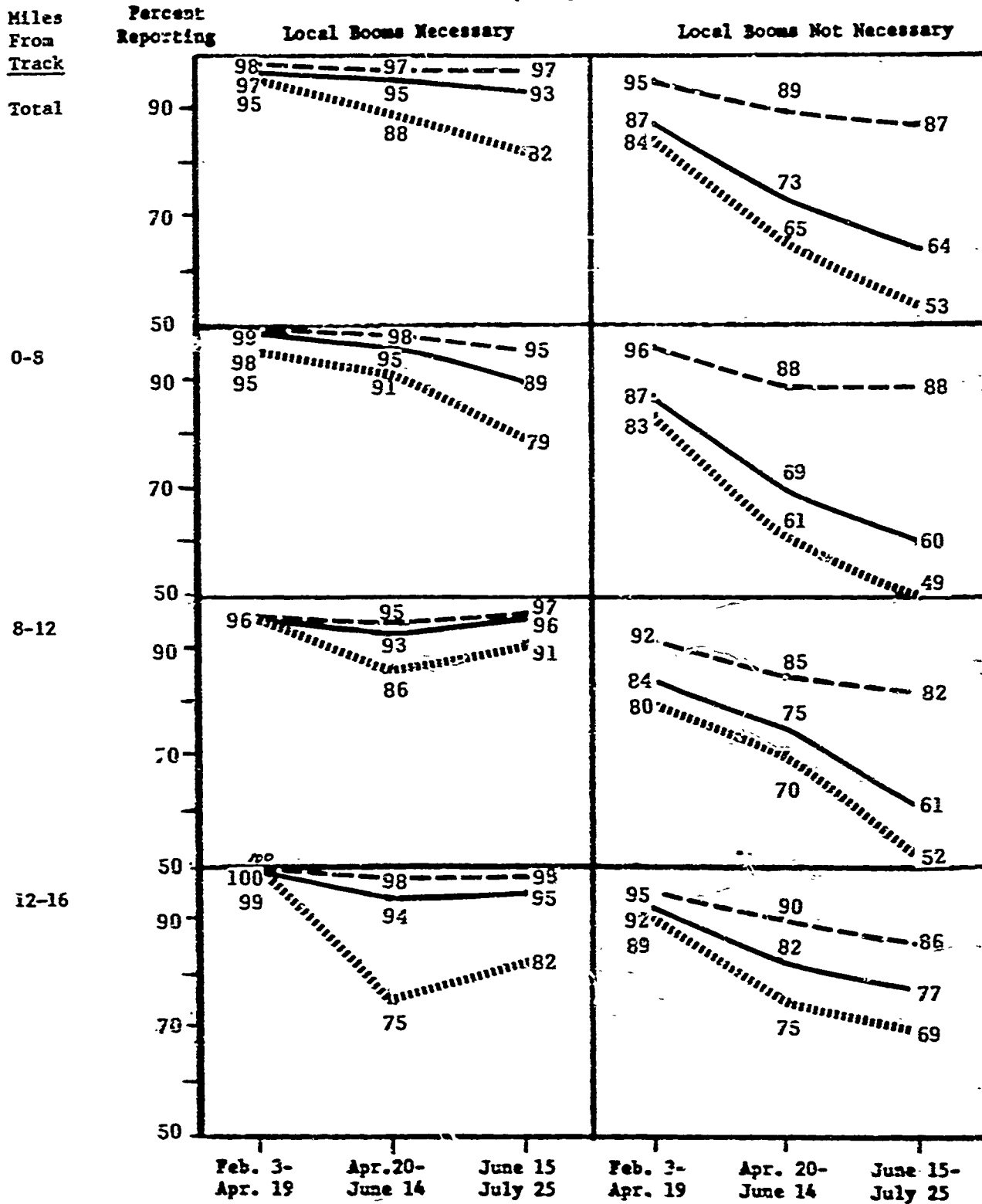
	Miles from Ground Track			
	Total*	0 - 8	8 - 12	12 - 16
<u>Feel Local Booms Necessary</u>				
Total.	17%	27%	17%	17%
Annoyed at end	2	4	0	0
Not annoyed at end	1	1	1	1
<u>Feel Local Booms Not Necessary</u>				
Total.	8%	10%	6%	27%
Annoyed at end	10	13	7	3
Not annoyed at end	2	2	3	0

* Includes only persons who feel people should complain if annoyed.

Table 19

REPORTED ABILITY TO ACCEPT EIGHT BOOMS PER DAY
BY FEELINGS OF NECESSITY AND ANNOYANCE WITH BOOMS AT END OF STUDY

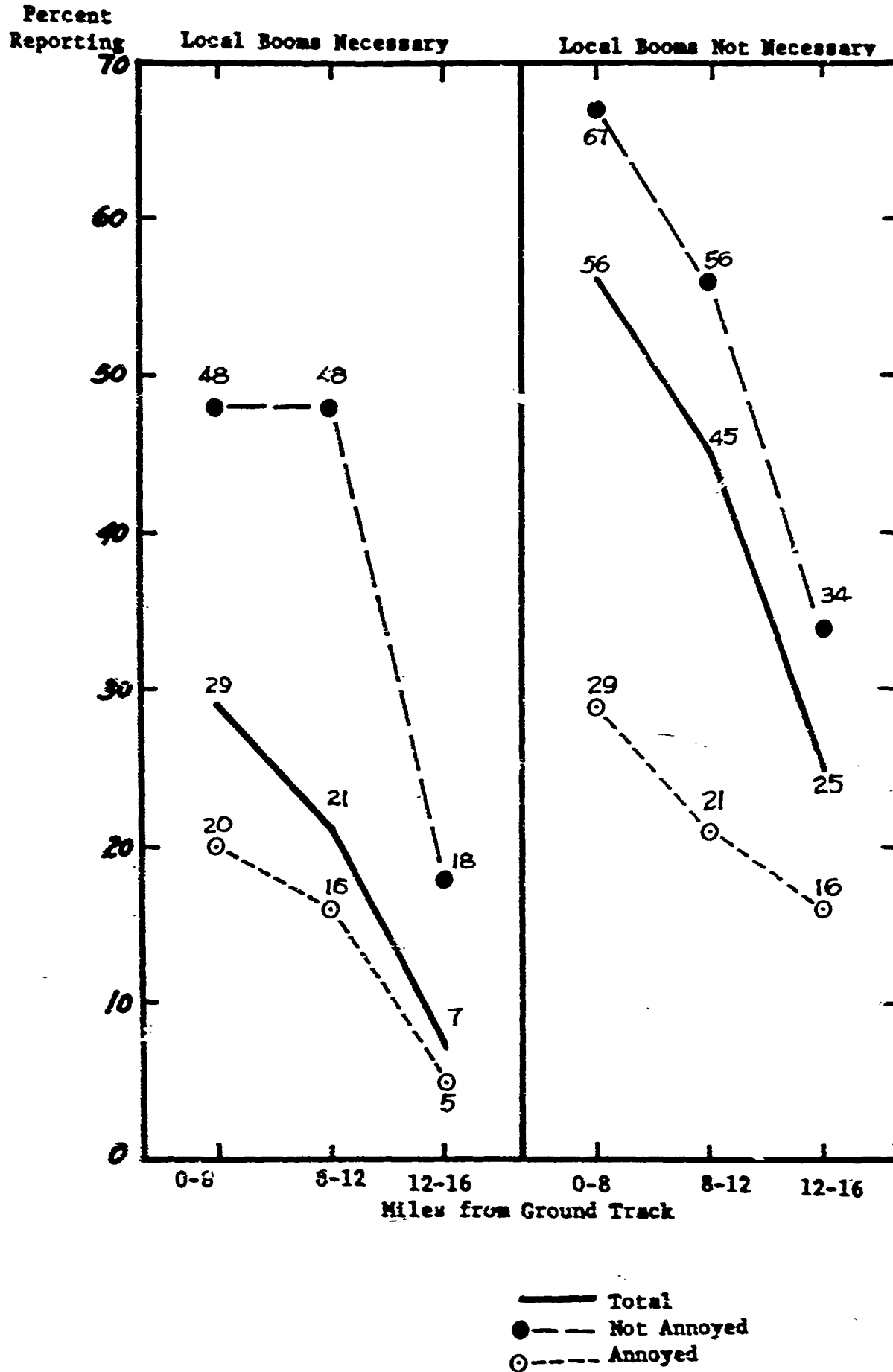
Oklahoma City Area
February-July 1964



— Total
 - - - Not Annoyed at End
 Annoyed at End

Table 20

REPORTS OF DAMAGE BY BOOMS
BY FEELINGS OF NECESSITY AND ANNOYANCE WITH BOOMS AT END OF STUDY
Oklahoma City Area
February-July 1964



B. Some Characteristics of Actual Complainers

This section of the report deals with a description of 113 persons who said they actually contacted the FAA. In many ways they are the most intensely annoyed and disturbed group and their characteristics may be taken as typical of the hard core of those who oppose the booms.

1. Reports of Damage

Damage and complaining: About 86 percent of all complainers felt they had sustained some damage to their personal property. In contrast, only a third of the non-complainers felt this way. Moreover, 35% of the complainers report new damage during each separate interview compared to only 5% of the non-complainers. These comparisons are shown in Table 21.

2. Long Range Acceptability

Fewer complainers adapt: Some complainers are not completely hostile to eventual acceptance of the booms. Table 22 shows that almost 40% of the complainers feel they might be able to eventually get along with booms. Almost 70% felt this way at the first interview but subsequent experiences of alleged damage, changes in basic attitudes toward the booms, and changes in boom intensity reduced this favorable percentage. About eight out of 10 non-complainers end the study with the belief that they can live with the booms.

Night booms: The bottom of Table 22 presents some feelings about night booms. In this study no actual night booms were scheduled, so the area did not experience them. As part of the final questions (during the first interview) asking about expectations of long range adaptability everyone was asked, "And how about several civilian booms every night? Do you think you could very likely learn to live with it?" As can be seen in Table 22, only about a third of the complainers who feel they can accept day booms feel they can also live with night booms. Among non-complainers the percentage drops from 93% who say they can accept day booms to 71% for night booms. These relationships are in line with other studies that night disturbances which interfere with sleep are generally considered more serious than daytime disturbances. The levels of response, however, must be cautiously evaluated, since the answers are not based on actual experiences but are imaginative projections of beliefs. It is possible that expectations would change over time after actual interference with sleep is experienced.

Some evidence on sleep interference: Even in this study, as seen in Table 4, 18% reported some sleep interference and 17% rest interference. Such interference was found more than a little annoying by almost 80% of those reporting sleep interference. In contrast, only 57% who reported rattles and vibration interference also reported more than a little annoyance. These are indications that sleep interference may be regarded as more serious. The extent of annoyance and long range adaptability to night booms, however, will require more direct research with the actual situation.

3. Personal Characteristics

Finally, some of the personal characteristics of complainers, which generally represent those of annoyed persons as well, are shown in Table 23. In general, complainers are middle-aged females, with older children and smaller families. They have somewhat more education and have higher incomes. They also have a much greater general complaint potential, 54% vs. 25% for non-complainers. They less often feel the SST is even probably necessary, 40% vs. 70% for non-complainers, and less often feel local booms are necessary, 19% vs. 58%.

Table 21
 REPORTS OF DAMAGE
 BY COMPLAINERS AND NON-COMPLAINERS

Oklahoma City Area
 February-July 1964

<u>Number Reports of Damage</u>	<u>Complainers</u>	<u>Non-Complainers</u>
Number of respondents	113	2739
Three.	35%	5%
Two.	32	9
One.	19	18
Some.	86	32
None.	14	68

Table 22

**REPORTED ABILITY TO ACCEPT EIGHT BOOMS PER DAY AND SEVERAL BY NIGHT
BY COMPLAINERS AND NON-COMPLAINERS**

Oklahoma City Area

February-July 1964

	<u>Complainers</u>			<u>Non-Complainers</u>		
	Feb. 3- Apr. 19	Apr. 20- June 14	June 15- July 25	Feb. 3- Apr. 19	Apr. 20- June 14	June 15- July 25
<u>Eight per Day</u>						
Could not accept. . .	24%	49%	57%	5%	12%	17%
Don't know.	7	2	4	2	2	3
Could accept.	69%	49%	39%	93%	86%	80%
Very likely. . . .	40	28	15	80	69	62
Might.	29	21	24	13	17	18
<u>Several by Night</u>						
Could not accept. . .	64%			21%		
Don't know.	7			8		
Could accept.	29%			71%		
Very likely. . . .	13			48		
Might.	16			23		

Table 23

SELECTED PERSONAL CHARACTERISTICS
OF COMPLAINERS AND NON-COMPLAINERS

Oklahoma City Area

February-July 1964

	<u>Complainers</u>	<u>Non-Complainers</u>
Number of respondents	113	2739
<u>Family Composition</u>		
Adults only	50%	48%
Children over 6	35	26
Children under 6.	15	26
<u>Size of Family</u>		
One person.	3%	10%
Two-three	62	49
Four or more.	35	41
<u>Age</u>		
Under 40.	28%	38%
40 - 64	53	40
65 or more.	16	21
Age not given	3	1
<u>Sex</u>		
Male.	26%	31%
Female.	74	69
<u>Education</u>		
Elementary school	16%	23%
High school	56	53
College	28	24
<u>Income</u>		
Under \$8000	65%	73%
\$8000 - 14,999.	19	17
\$15,000 or more	4	4
Income not given.	12	6

G. Some Remaining Gaps in Knowledge About Community Reactions to Sonic Booms

List of gaps: A brief description of some of the remaining major gaps in knowledge about community reactions to sonic booms constitutes the final section of this report. Four of the major unresolved issues requiring additional research are:

1. The Effects of Nighttime Booms

No nighttime booms were experienced by Oklahoma City in this study. The limited daytime sleep interference reported in the findings suggests that such interference creates a serious reaction and should be studied more directly.

2. The Effects of Sonic Booms Above the Intensity of 1.5 PSF

Sonic booms in the final phase of this study actually averaged only slightly above 1.5 PSF, although programmed at 2.0 PSF. It is not known whether the SST, which will be heavier and larger than the Air Force planes flown in this test series, will also generate booms as far below the programmed level as those experienced in Oklahoma City. Consequently, it may be desirable to test further public reactions to booms which actually measure closer to 2.0 PSF.

3. Effects of Time on Acceptability of Sonic Booms

A clear cut test of the effects of time on sonic boom reactions was not possible in this study. The intensity of the booms was increased over time consequently combining the effects of time and intensity of the boom. The effects of prolonged exposure to a constant sonic boom intensity should be studied further.

4. Effects of An Optimum Public Information Program

The important effects on acceptability of sonic booms have been shown for the following attitudes: the importance of the SST, the necessity of having local booms, and the lack of damage caused by booms. The development of these favorable attitudes or beliefs should be amenable to a vigorous public information program and should be tested in a real campaign.